BLUEPRINT READING FOR SHIPFITTERS

A WORKBOOK

Bulletin 345-B

Name of Trainee_____

Address_____

School_____

Instructor_____

Instructor's Comments_____

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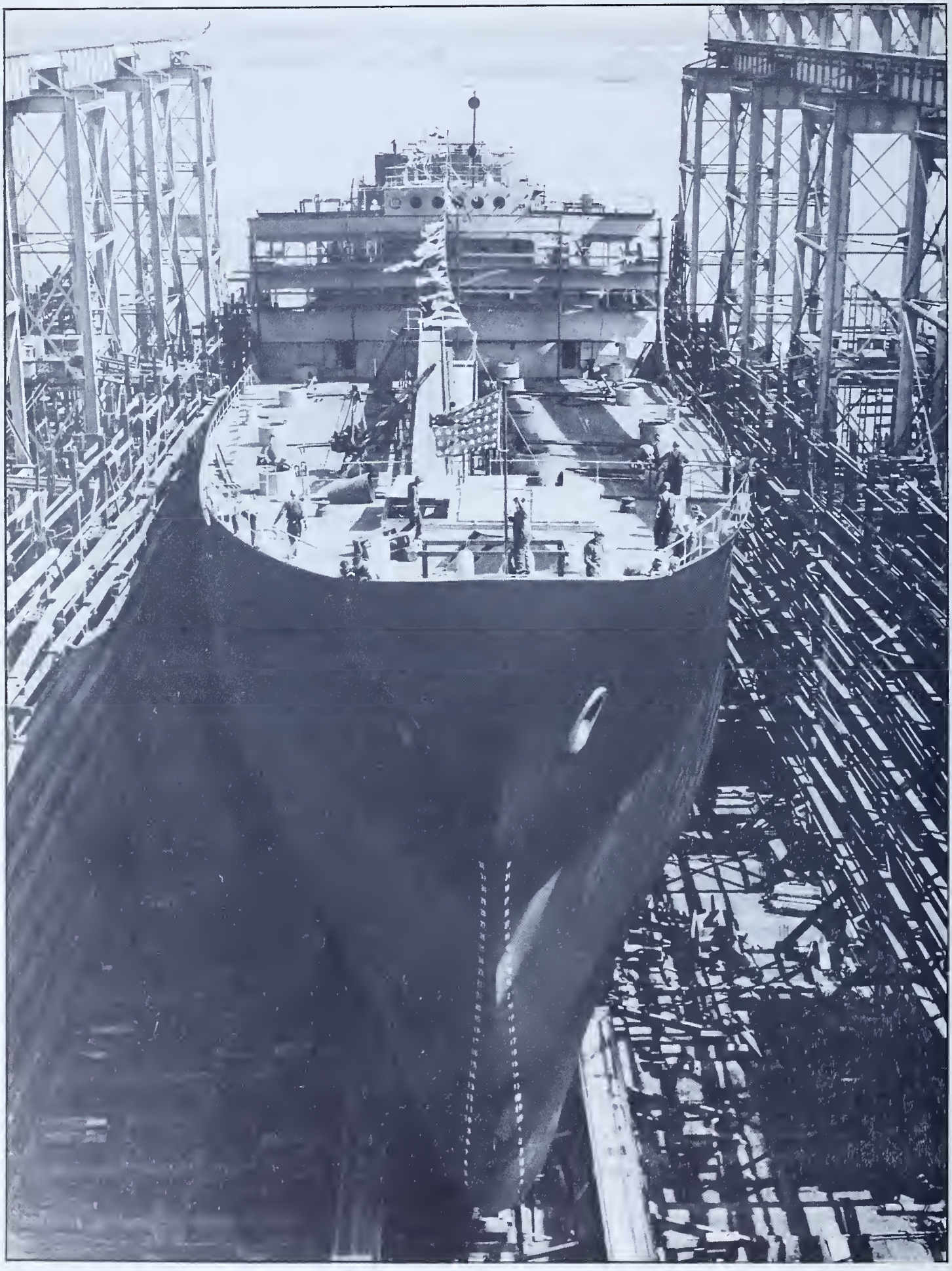
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF PUBLIC INSTRUCTION
HARRISBURG
1942

Vocational Training
for
War Production Workers



Launching a Typical All-Weld Tanker

BLUEPRINT READING FOR SHIPFITTERS

(A WORKBOOK FOR BEGINNING AND ADVANCED TRAINING)

Bulletin 345-B

Prepared by

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF PUBLIC INSTRUCTION
DIVISION OF INDUSTRIAL EDUCATION

in Cooperation With

SUN SHIPBUILDING AND DRY DOCK COMPANY
CHESTER, PENNSYLVANIA

SCHOOL DISTRICT, CITY OF CHESTER
CHESTER, PENNSYLVANIA

and

UNITED STATES OFFICE OF EDUCATION
THE FEDERAL SECURITY AGENCY

Commonwealth of Pennsylvania
DEPARTMENT OF PUBLIC INSTRUCTION
Harrisburg
1942

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Washington, D. C.

Foreword

This workbook has been prepared expressly to supplement the manipulative and technical instruction given to shipfitter trainees, and others who are learning the work of a shipfitter. Much of the work done by a shipfitter requires the ability to read ship blueprints; this bulletin should assist beginners and persons of considerable shipyard experience in acquiring this skill.

Since the work of the "Outside" shipfitter is closely allied with the work of the "Shop" shipfitter, this workbook is applicable to the training of workers in both fields. Other shipyard crafts may find in this bulletin items which may be valuable for reference purposes.

Common shipyard structural shapes and combinations of these shapes have been used in the development of visualization and size description. The prints are representative of portions of large prints which are commonly used by the shipfitter in his daily work.

Acknowledgment is made to the Sun Shipbuilding and Dry Dock Company, Chester, Pennsylvania, for active cooperation in the preparation of this instructional material.

Special acknowledgment is extended to Ralph Mull, Superintendent of the Sun Number "4" yard shop, and John M. Davidson, hull draftsman, for assisting in the preparation of text matter and drawings for this bulletin. The assistance of foremen, instructors, and mechanics in criticizing final copy is acknowledged.

Appreciation is extended to the Chester School District, and to D. Francis Hallowell, Coordinator of Chester Area, Vocational Training for War Production Workers, for assistance in the work.

This unit of instruction was prepared at the Chester Field Curriculum Laboratory of the Pennsylvania Department of Public Instruction. George M. Schaffer, Adviser, Division of Industrial Education, supervised the preparation of materials at the laboratory. The work was completed under the direction of Charles F. Zinn, Adviser, Division of Industrial Education, and under the general supervision of Paul L. Cressman, Director, Bureau of Instruction, and Urwin Rowntree, Chief, Division of Industrial Education.

FRANCIS B. HAAS
Superintendent of Public Instruction

October, 1942

BLUEPRINT READING FOR SHIPFITTERS

Introduction

Blueprint reading, fundamentally, is an essential of all shipbuilding. Ships are designed by engineers in every detail, and draftsmen express these details on paper in the form of working drawings. From these working drawings blueprints are made, supplying the necessary information which enables the workmen in the yard to do their particular jobs. The mold loftsmen lay out and construct templates by referring to these prints. In like manner the duplicators, shop shipfitters, erectors, shipfitters, and others, depend upon the information on blueprints to do their part in building a ship.

A blueprint may be thought of as the universal language of shipbuilders. It is a ready reference at all times, acting as a guide for the mechanics within the industry. The blueprint, therefore, is a form of abbreviated language; it is a shorthand method for conveying exact, detailed information. The working drawing, by means of symbols, abbreviations, and lines, conveys information which would require many pages of manuscript.

The reading of a blueprint is essential in the daily work of the shipfitter. Without a knowledge of how to read a blueprint he could not successfully perform his work.

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Part I — Shape Description

Part II — Size Description

Part III — Information Concerning the Reading of Ship Hull Prints

Part IV — Ship Hull Prints

PART I

SHAPE DESCRIPTION

Conventional Lines Used on Ship Hull Drawings

Shape Description **Information Sheet No. 1**

It is essential for the shipfitter to know the following kinds and weights of lines used on ship hull drawings. An understanding of these lines will aid in the interpretation of ship hull prints.

Border lines are heavy, full lines used as a border or as margin lines on drawings.

Object lines, or visible edge lines, are solid, full lines somewhat lighter in weight than border lines.

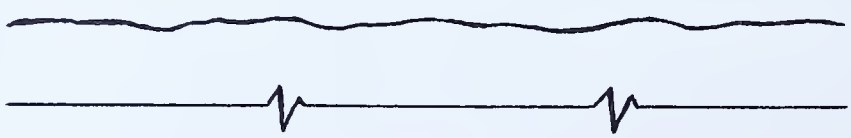
Invisible edges are represented by short dashes and are of medium weight.

Center lines are alternating light, long lines and short dashes.

Dimension lines are light, solid lines drawn parallel to the direction of measurement, have small arrowheads on each end, and are sometimes divided at some point to allow insertion of dimensions.

Extension lines are light, solid lines drawn from the object, perpendicular to the direction of measurement. Arrowheads in dimension lines should always touch the extension lines.

Broken lines, to represent breaks in a member, are of two types and are the same weight as object lines.



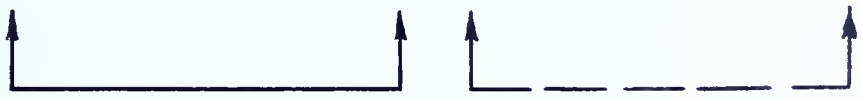
Conventional Lines Used on Ship Hull Drawings

Shape Description — Information Sheet No. 1

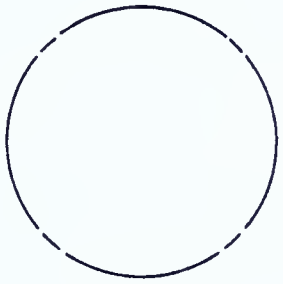
Invisible edges that are away from the plate or member are represented somewhat like a center line although the long lines are shorter than those of the center line.

Invisible plate edges are represented by a heavy, dashed line with light, solid lines on either side.

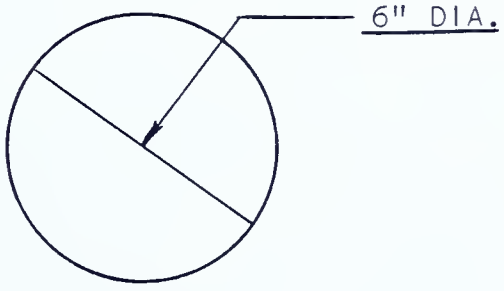
Section lines, which may be either light, solid lines, or long, uniform dashes, show the point at which a section is taken; the direction of the view is shown by the short lines terminating in arrowheads.



A detail line is usually a broken line, consisting of a long line and dash of medium weight.



Reference lines are light, solid lines generally oblique (slanting) used to point out special features on a drawing.



Idea of Views

Shape Description — Information Sheet No. 2

When describing an object in the shipfitter's language, the draftsman uses a drawing. This drawing is usually a series of illustrations of how the object would appear from various, selected positions. The term "view" is used to describe what would be seen from one of these positions. If the object is viewed from directly above, the *top view*, or *plan view*, would be seen. If the object is viewed from the right side, the *right side view*, or *right elevation*, would be seen. Similarly, if the object is viewed from the front, a *front view*, or *front elevation*, would be seen. See Fig. 1.

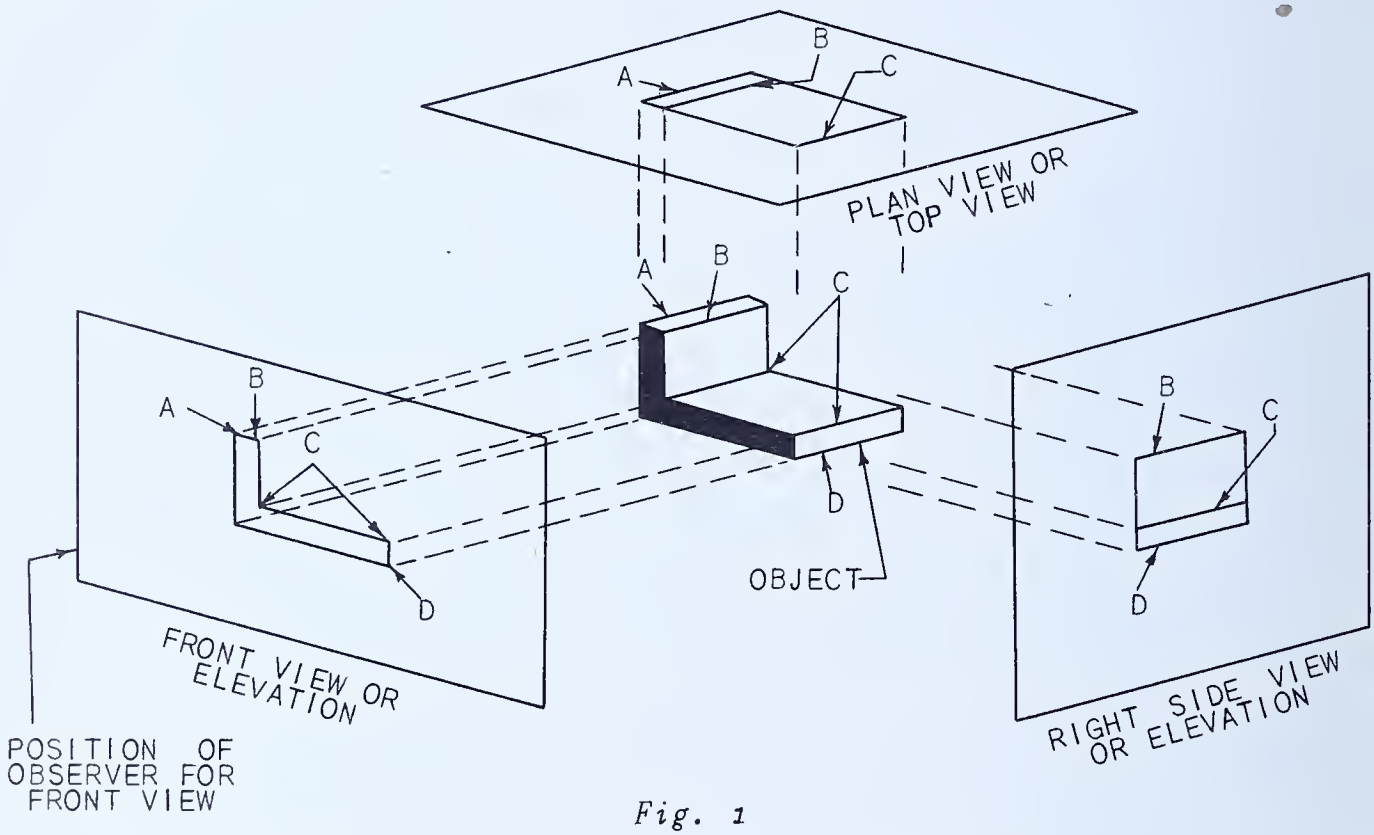
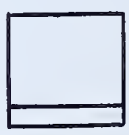


Fig. 1

The reading of blueprints requires the ability to visualize, since all working drawings are made from the three above-mentioned positions or a modification of them. Fig. 2 shows the object pictured in Fig. 1 as it would be visualized from different positions.

FRONT VIEW OR ELEVATION

TOP VIEW OR PLAN VIEW



RIGHT SIDE VIEW OR ELEVATION

Fig. 2

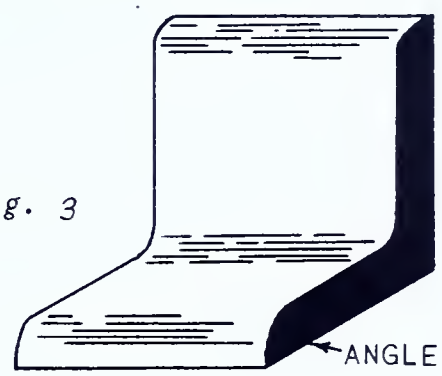
Visualization Practice

Shape Description — Assignment Sheet No. 1

NAME — DATE — GRADE

To the right is given the picture of a simple shape used in the shipyard. In the spaces below sketch the views called for. See Fig. 1 to determine how the shape must be visualized to draw the views wanted.

Fig. 3



1. In this space sketch the *front elevation.*

2. Draw the *top view*, or *plan view*, here.

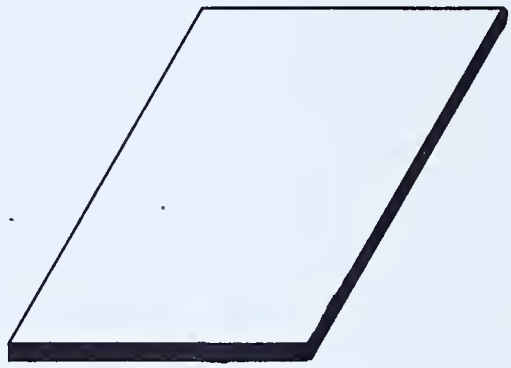
3. Sketch the *left side elevation* here.

4. Sketch the *right side elevation* here.

Shape Description — Assignment Sheet No. 1

Sketch the views of the plates and shapes as indicated in the spaces provided on these sheets.

5. PLATE

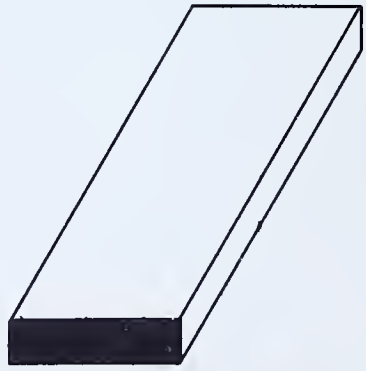


PLAN VIEW — RIGHT SIDE ELEVATION

6. SQUARE BAR

FRONT ELEVATION — RIGHT SIDE ELEVATION

7. FLAT BAR



FRONT ELEVATION — RIGHT SIDE ELEVATION

In order to show clearly the shape of an object, more than one view must be drawn. The views may be any views depending on the peculiarity of the object; however, the top, front, and right side elevations are considered to be a more or less standard combination.

The views of an object must have a definite relation to each other. They are not drawn haphazardly as was done when studying visualization. This relation, or orderly arrangement of views, is absolutely necessary if the views are to be interpreted clearly.

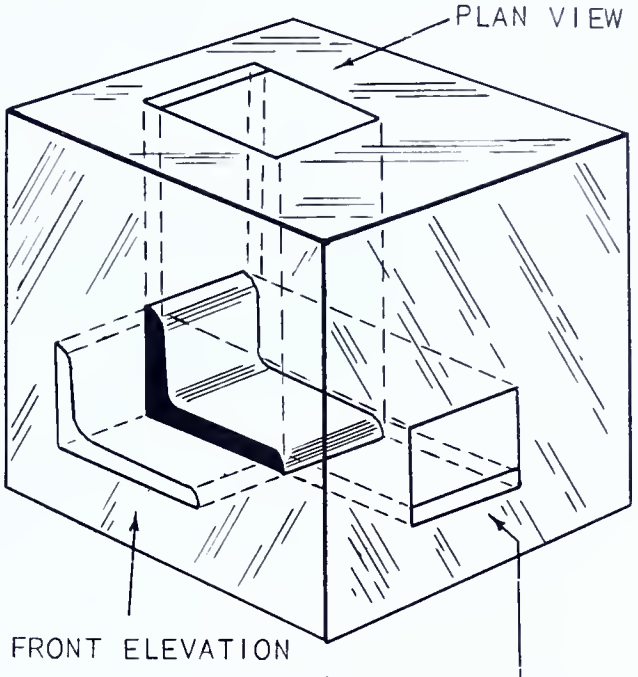


Fig. 4

Imagine a rectangular object to be suspended in a glass box. Now look into the top, front, and right side of the box; three views will be seen as shown in Fig. 4.

Fig. 5 shows the box of Fig. 4 with the top and right side revolved to form a flat surface.

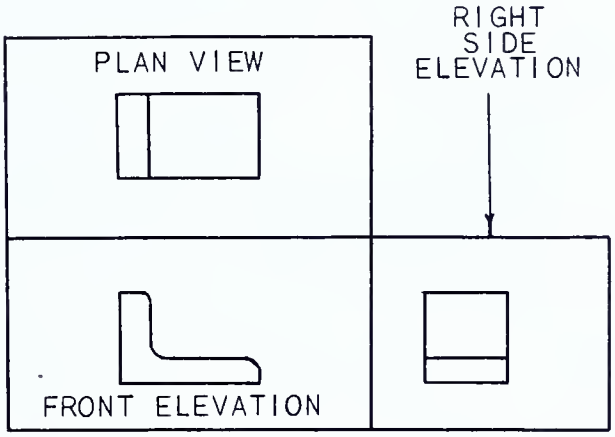


Fig. 5

Fig. 6 shows the views with the box removed and the shading eliminated. This was added to aid in visualizing particular views. These views are in proper relation to each other. *They need no labels, since their names should be known by their positions in relation to each other.* The top view, or plan view, is always in a position directly above the front elevation, and the right side view, or side elevation, is always shown directly to the right of the front elevation.

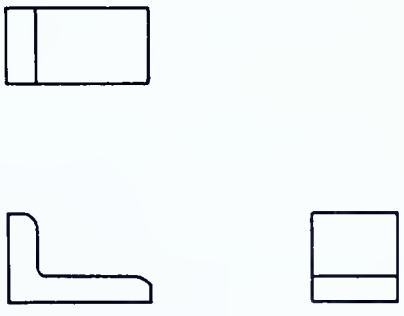


Fig. 6

Projection

Shape Description **Information Sheet No. 4**

The interpretation as well as the making of drawings is aided by what is called "projection". This means the carrying over of a point or corner from one view to another. Note Fig. 7 how the corner on one view has a line on the other views directly opposite it.

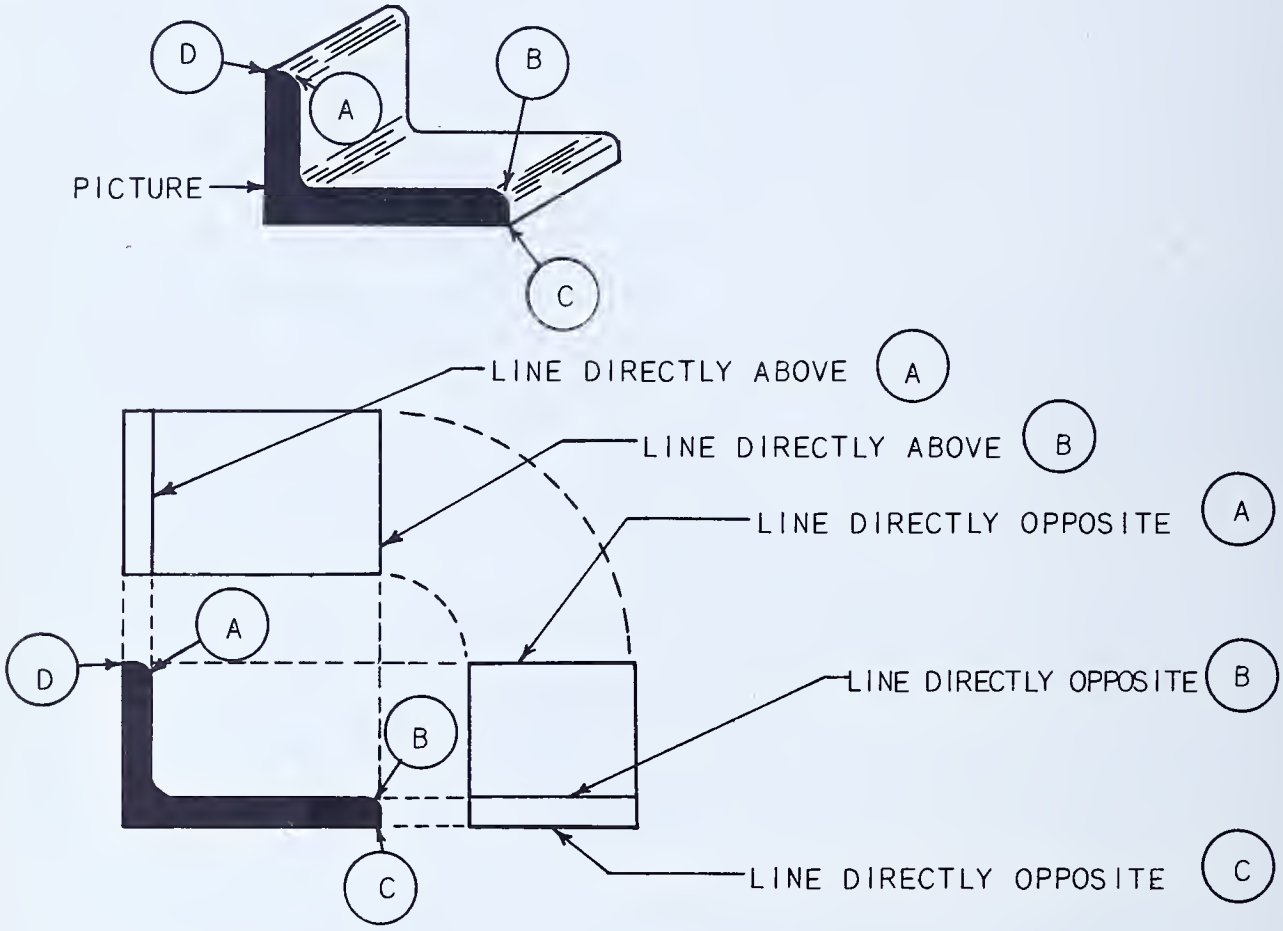


Fig. 7 - Showing Relation of Views and Parts of Views

FUNDAMENTAL TRUTHS

1. All parts of the front elevation are just as long as corresponding parts of the top elevation.

2. All parts of the end elevation are just as wide as corresponding parts of the top elevation.

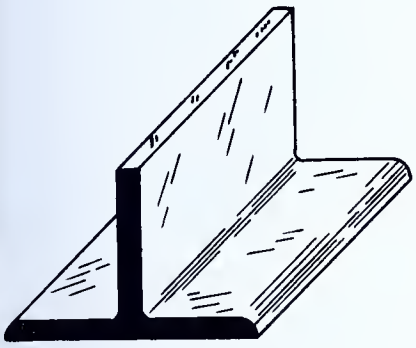
3. All parts of the front elevation are just as high as corresponding parts of the end elevation.

Shape Description — Assignment Sheet No. 2

NAME — DATE — GRADE

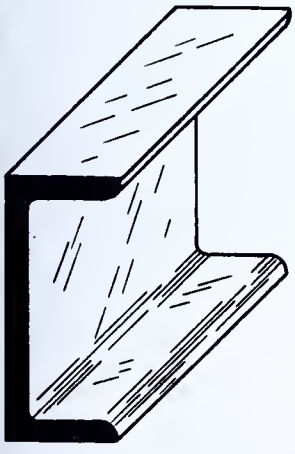
Sketch the front elevation, plan view, and side elevation of the following shapes. The views should be located in their proper relation as shown in Figs. 5 and 6.

1.



TEE BAR

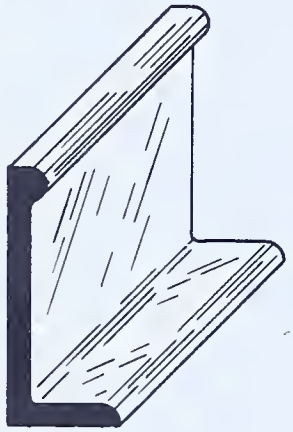
2.



CHANNEL BAR

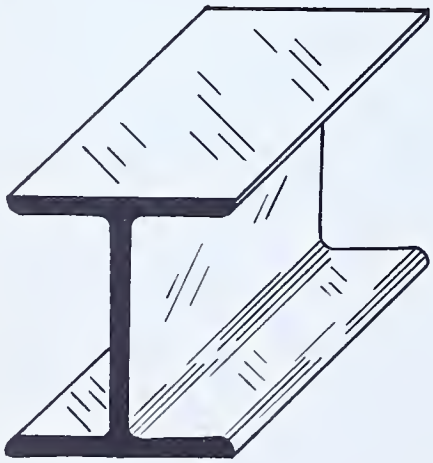
Shape Description — Assignment Sheet No. 2

3.



BULB ANGLE

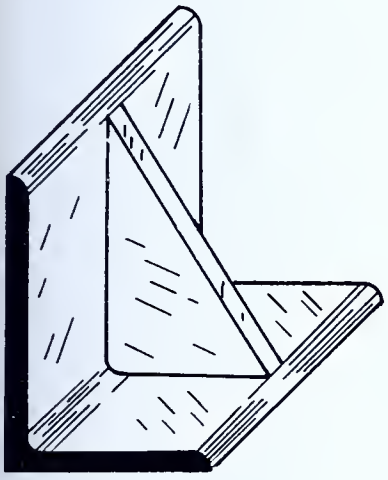
4.



I-BEAM

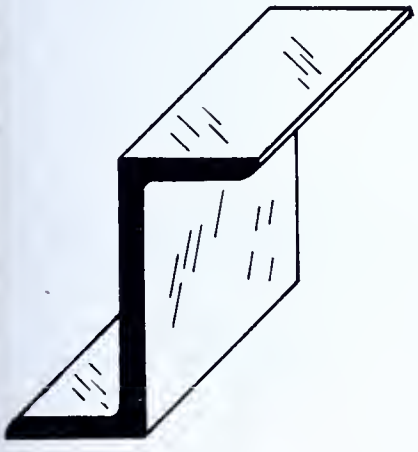
Shape Description Assignment Sheet No. 2

5.



ANGLE BAR AND BRACKET

6.



ZEE BAR

Invisible Edges

Shape Description — Information Sheet No. 5

Very often when viewing an object from some chosen position, certain edges are not visible from that position since they are located on the opposite side or are inside of the object. If the object were X-rayed, it would be possible to see these edges. Of course, by the powers of visualization, it is known that these lines are invisible; but from what has been learned, their positions can be shown in the views by projection. On ship hull drawings these invisible lines are indicated by making a dash line instead of a continuous line. See Fig. 8.

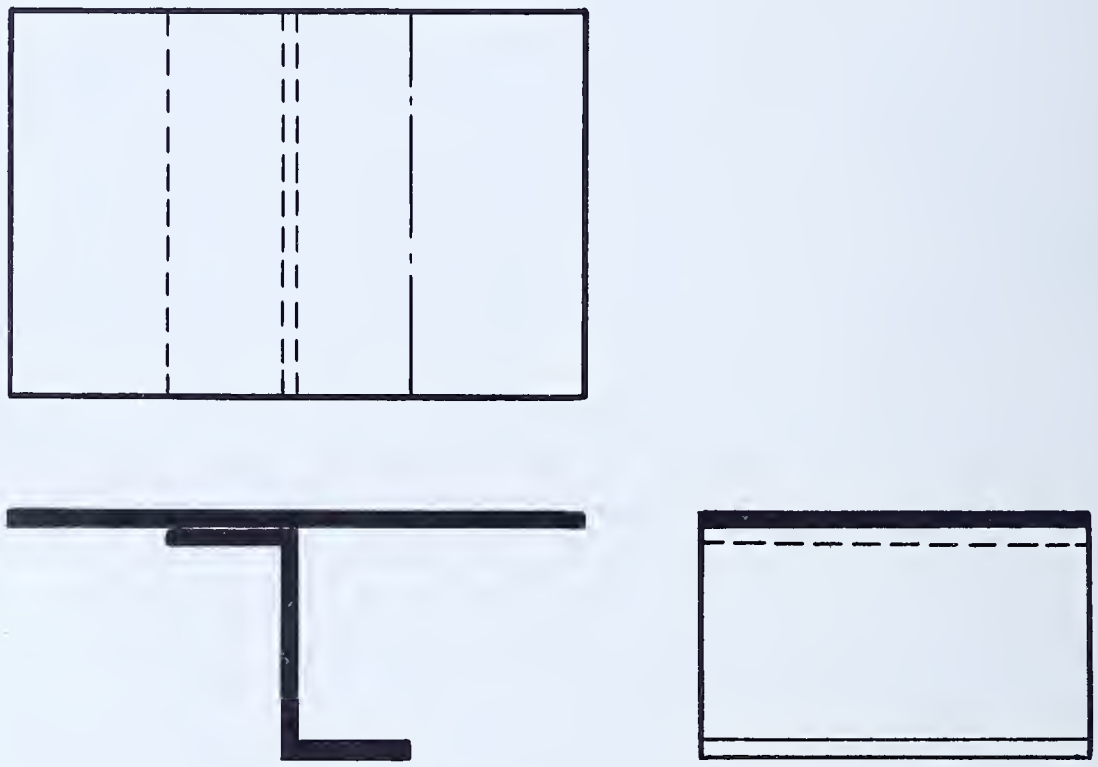


Fig. 8

The preceding discussion, with its examples, shows that *difference in meaning can be indicated on a drawing by differentiating the lines.* The uses of different lines on working drawings will be evident from drawings set forth on succeeding pages. This lesson, however, is concerned with the use of lines to denote visible and invisible edges.

Invisible Edges

Shape Description — Assignment Sheet No. 3

NAME — DATE — GRADE

Sketch the views of the plates and shapes as indicated in the spaces provided on these sheets.

1. PLATE LAP

RIGHT SIDE ELEVATION

2. PLATE AND ANGLE

RIGHT SIDE ELEVATION

3. CHANNEL

RIGHT SIDE ELEVATION

4. I-BEAM

RIGHT SIDE ELEVATION

Shape Description — Assignment Sheet No. 3

5. PLATE AND ANGLE

LEFT SIDE ELEVATION

RIGHT SIDE ELEVATION

PLAN VIEW

6. PLATE AND BULB ANGLE

LEFT SIDE ELEVATION

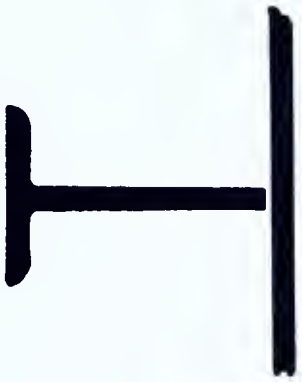
RIGHT SIDE ELEVATION

PLAN VIEW

Invisible Edges

Shape Description — Assignment Sheet No. 3

7. PLATE AND TEE BAR



LEFT SIDE ELEVATION — RIGHT SIDE ELEVATION

PLAN VIEW

8. PLATE AND ZEE BAR

LEFT SIDE ELEVATION — RIGHT SIDE ELEVATION

PLAN VIEW

Cylindrical Objects

Shape Description — Information Sheet No. 6

Sketching cylindrical objects brings into use another type of line, - the center line. Look up its construction on page 2. *From this time on, distinction should be made between the weights of lines as well as the way they are constructed.*

A good procedure to follow in sketching cylindrical objects is given below.

Steps Used in Drawing Cylindrical Objects

1st. Draw center lines lightly, as illustrated.

2nd. Draw circles--make lines heavy.

3rd. Draw light-weight projection lines through side elevation position.

4th. Draw vertical lines dividing side elevation into its major divisions. Draw lightly.

5th. Trace in the side elevation in heavy outline.

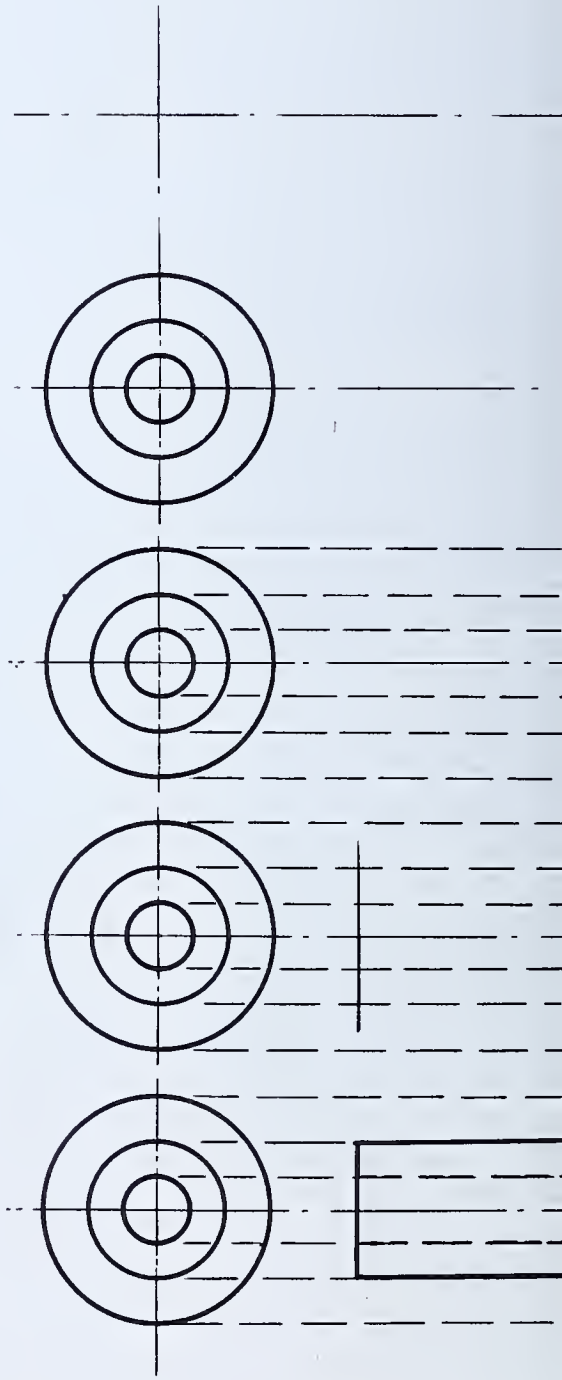


Fig. 9

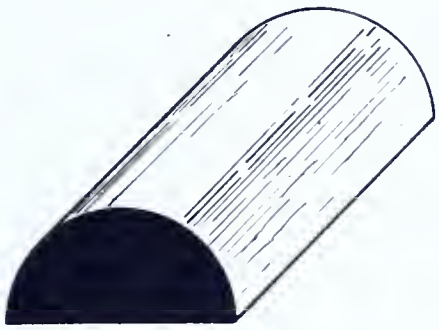
Curved Edges

Shape Description — Assignment Sheet No. 4

NAME — DATE — GRADE

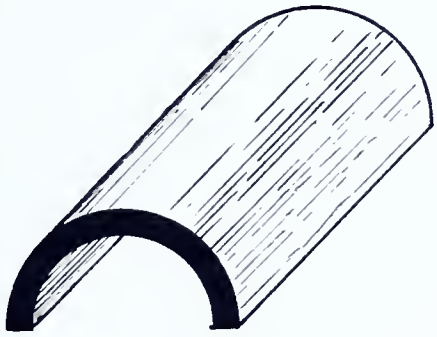
Sketch the views of the shapes as indicated in the spaces provided on this sheet.

1. SOLID HALF ROUND



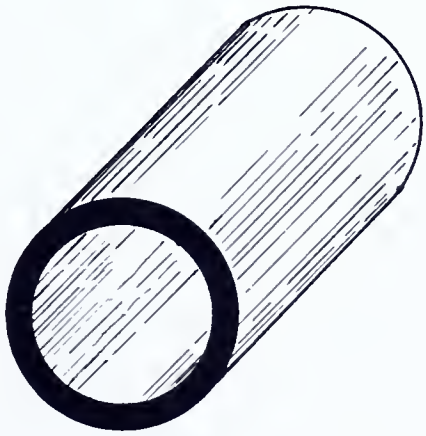
PLAN VIEW — RIGHT SIDE ELEVATION

2. HOLLOW HALF ROUND



PLAN VIEW — RIGHT SIDE ELEVATION

3. PIPE



FRONT ELEVATION — RIGHT SIDE ELEVATION

Frequently it is unnecessary to show all three views of an object. If a shipfitter can understand a print by referring to only one or two views of the object, it is necessary for the draftsman to draw only the views that the shipfitter will need to do the job.

If, for example, three views of a piece of pipe were to be shown, as in Fig. 10, it would be found that the top and front views would

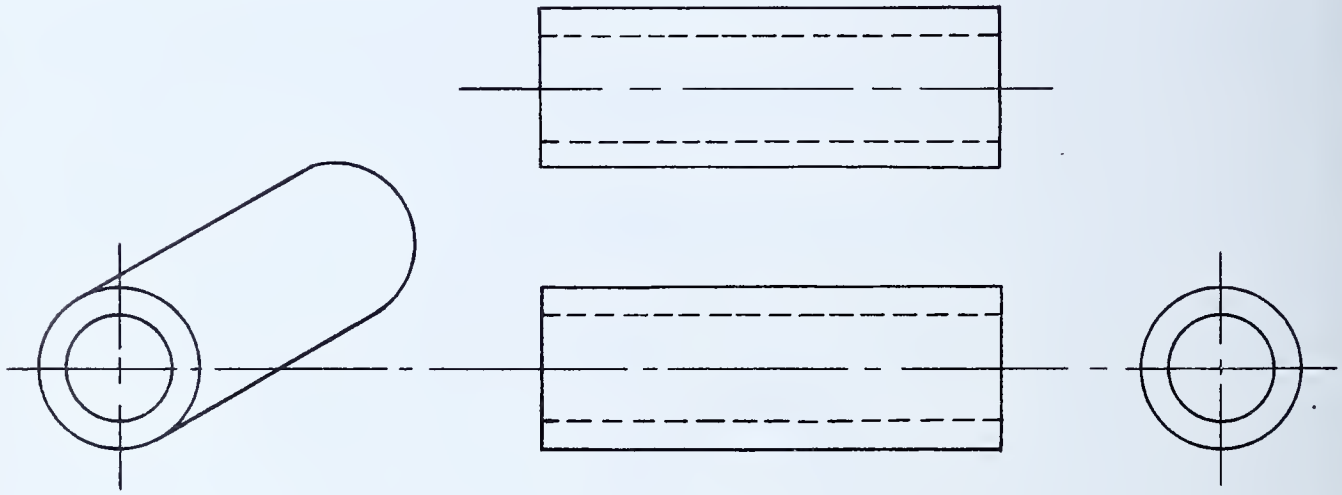
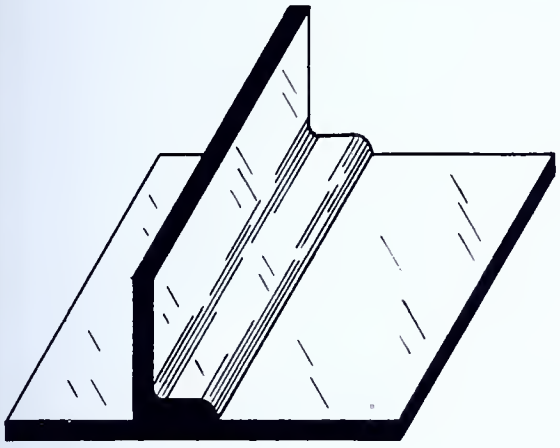


Fig. 10

be identical. Therefore, only two views would be necessary to show the pipe in every detail. Many shipfitting prints are drawn with only one or two views since they show the detail of the shape or structure sufficiently for the shipfitter to do his work.

Shape Description — Assignment Sheet No. 5

NAME — DATE — GRADE

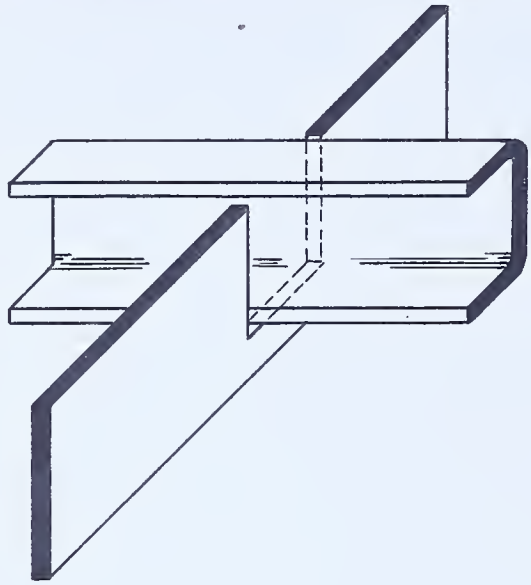


Sketch the necessary views of this assembly. Be sure that all details are shown on the sketch.

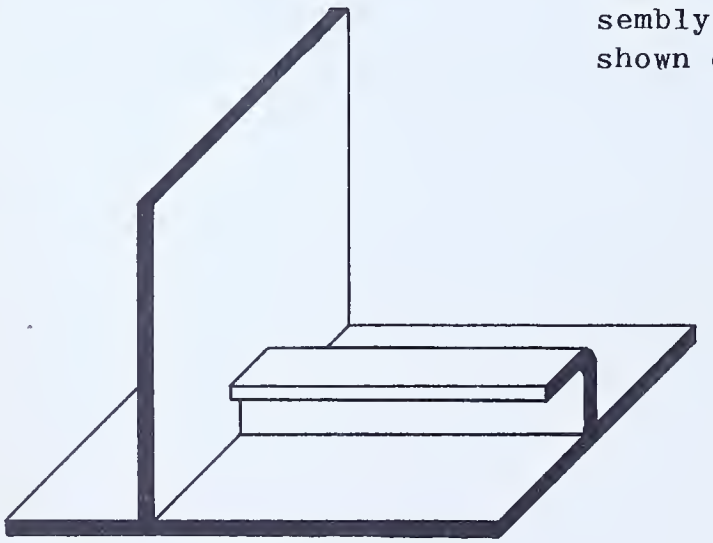
Sketch the necessary views of this assembly. Be sure that all details are shown on the sketch.

Modification of the Three View Principle

Shape Description — Assignment Sheet No. 5



Sketch the necessary views of this assembly. Be sure that all details are shown on the sketch.



Sketch the necessary views of this assembly. Be sure that all details are shown on the sketch.

Shape Description **Information Sheet No. 8**

Sometimes the interiors of objects are so complicated that it is difficult to show them clearly with dash lines. Too many hidden edge lines are confusing and difficult to interpret.

To show the construction clearly in many hollow objects, the front or near part is imagined to be removed, making the interior of the object visible. *Edges are consequently shown with a solid line* instead of a dash line; and the cut surface is hatched; that is, slanted lines are drawn across the cut surface. Study Figs. 11 and 12 below carefully. Re-read the preceding text while studying these figures.

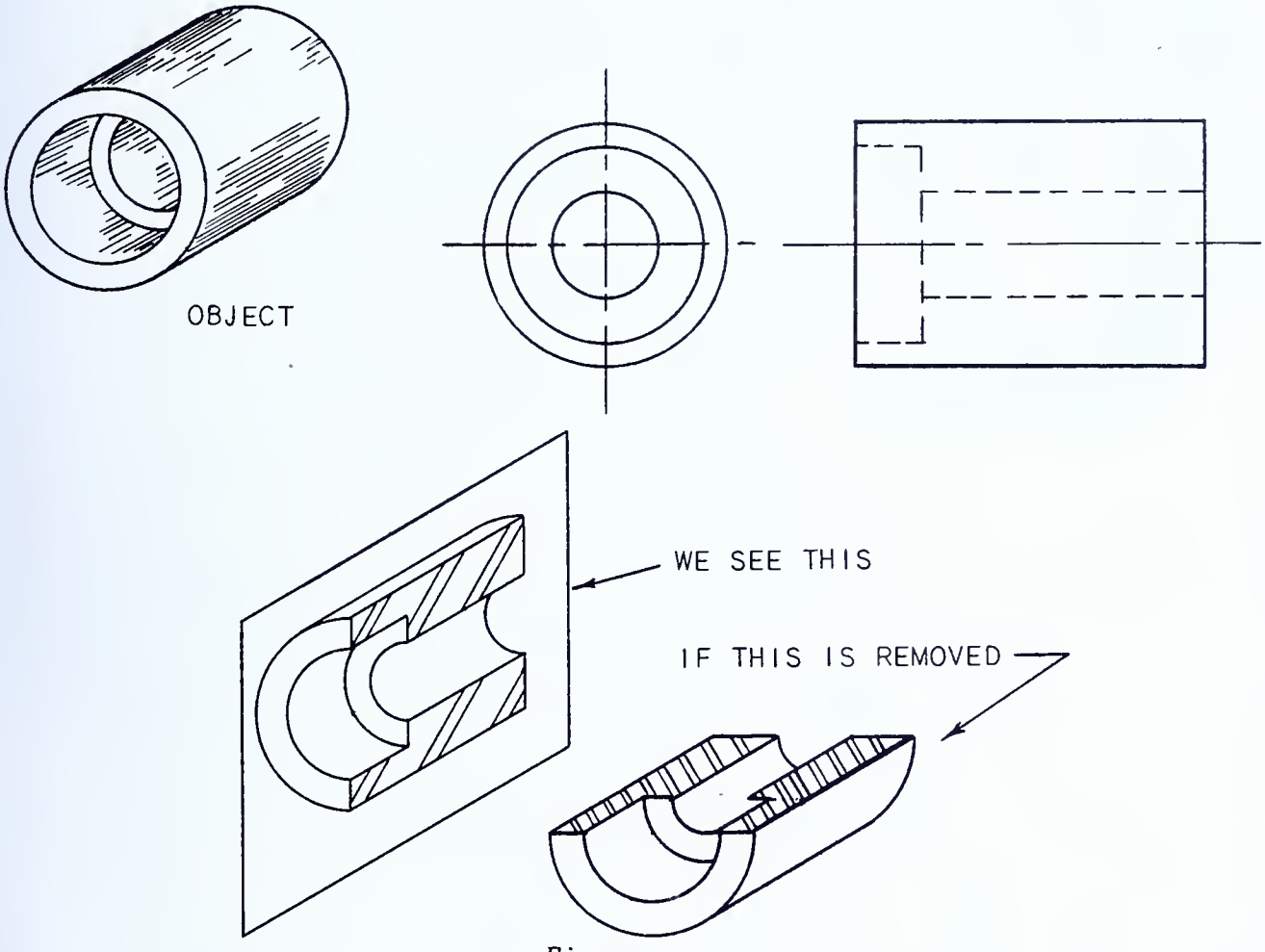


Fig. 11

Sectional representations are shown in full on hull prints. The difference between a cross section of a hull drawing and that of a mechanical drawing is shown in Fig. 12.

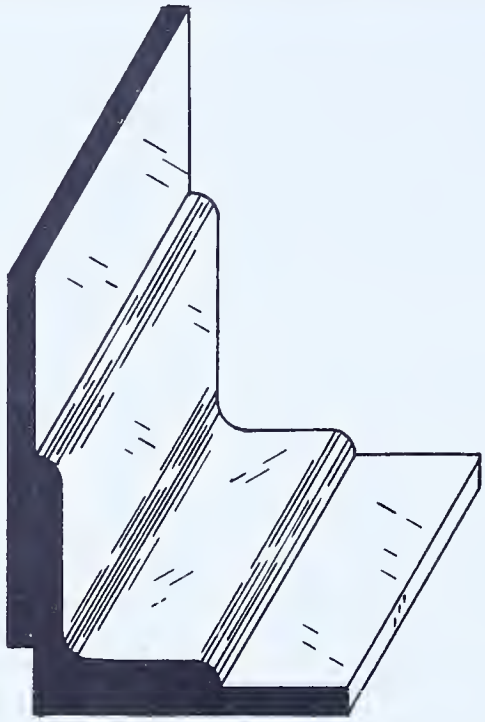
HULL DRAWING – CROSS SECTION MECHANICAL DRAWING – CROSS SECTION

Fig. 12

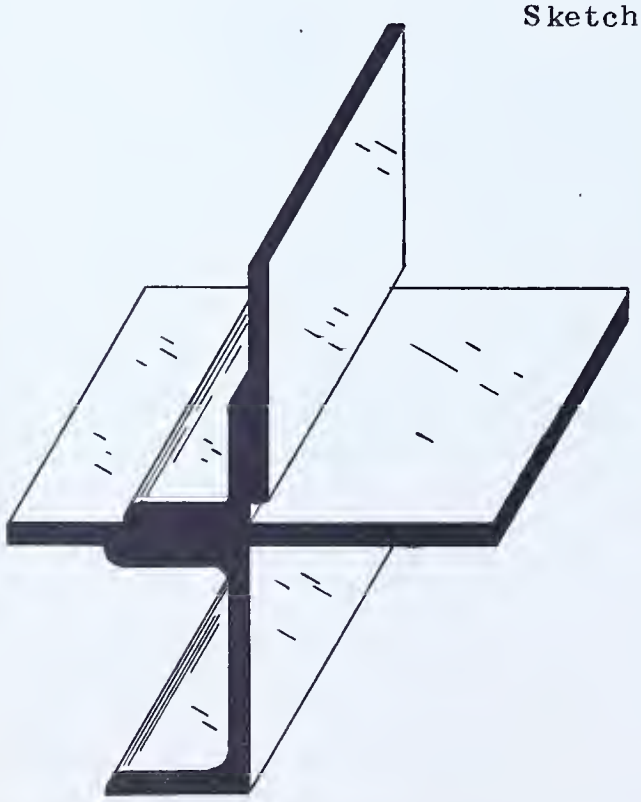
Shape Description — Assignment Sheet No. 6

NAME — DATE — GRADE

Sketch a sectional view of this assembly.



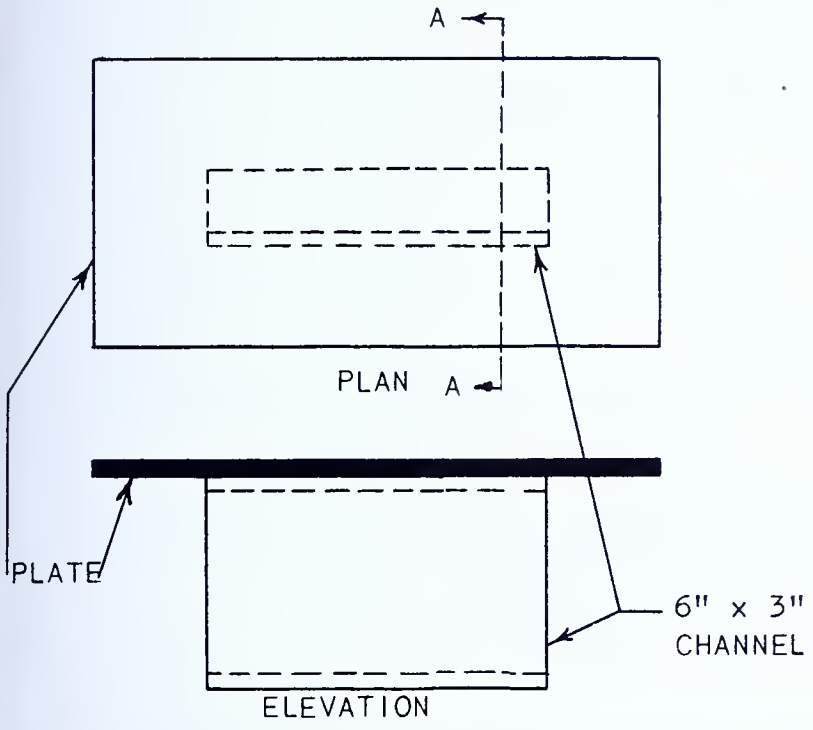
Sketch a sectional view of this assembly.



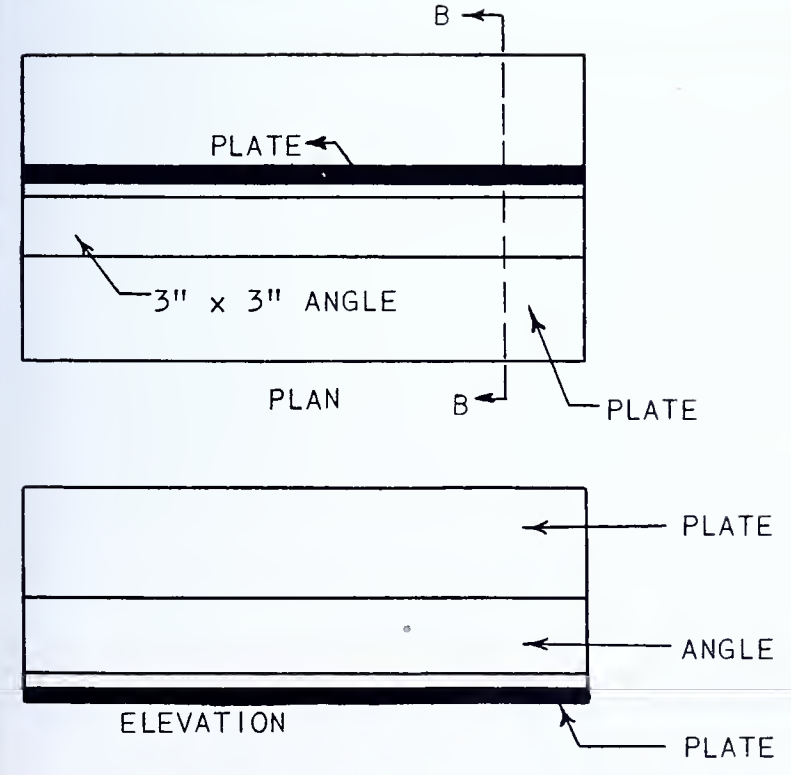
Sectional Views

Shape Description **Assignment Sheet No. 6**

Show section "A-A"



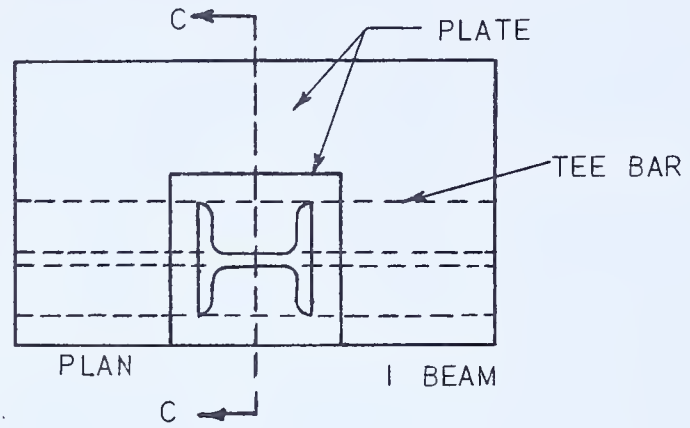
Show section "B-B"



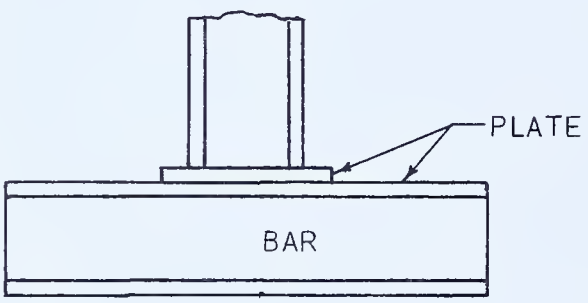
Sectional Views

Shape Description

Assignment Sheet No. 6

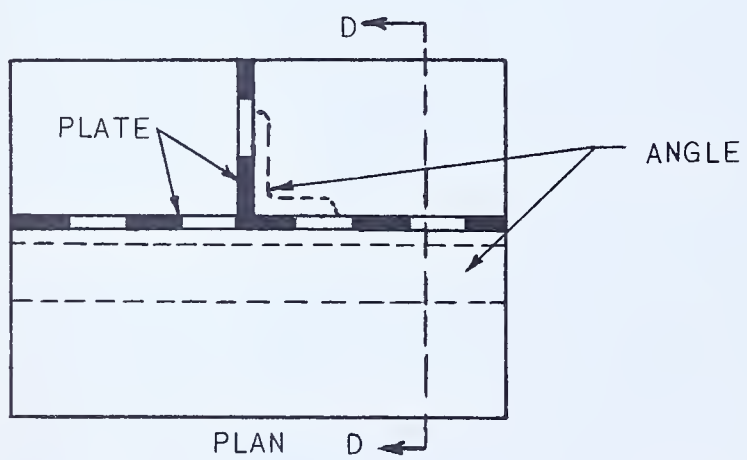


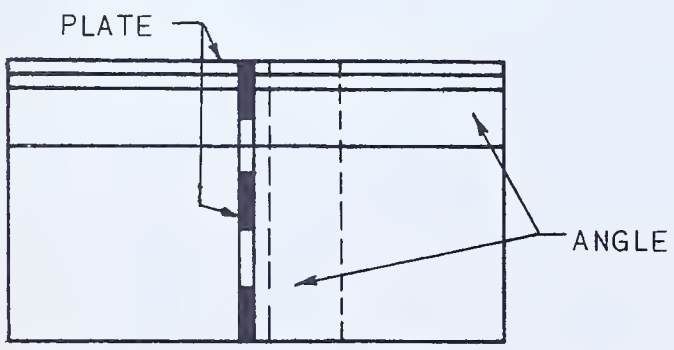
Show section "C-C"



ELEVATION

Show section "D-D"





ELEVATION

PART II

SIZE DESCRIPTION

How to Read a Rule

Size Description — Information Sheet No. 9

In order for the shipfitter to have his work agree with the blueprint, he must be able to measure distances from center lines, buttock lines, etc. Therefore, it is necessary for him to be able to read a rule to do his work, just as the draftsman was able to read a rule to make the drawing.

SCALE DIVISIONS

When a rule is examined, it is found that there are many marks or fine divisions along the edge of the tool. These marks are for the purpose of dividing the length of the rule into many equal parts and enabling the worker to measure distances. No matter how long the rule may be, each mark is equidistant from similar adjoining marks. For example, all inch spaces are equal, all half-inch spaces are equal, etc.

READING MEASUREMENTS

Measurements are given in feet, inches, and parts of an inch. For example, a distance from a water line may be read as two feet, four and one-half inches, commonly expressed in figures as 2'-4½". A foot mark is always represented by a short vertical line just above and to the right of the number. Inch marks are represented by two short vertical lines close together, above, and to the right of the number. If we were to read the size of a plate, we would find the plate size to be expressed as ½" x 2' x 4'. The x used here means "by". The plate measurement, therefore, should read "one-half inch by two feet by four feet".

READING MEASUREMENTS CORRECTLY

A mechanic must be able to read a rule quickly and accurately. He will lose a lot of time and cause others to lose time unless he is able to read a rule correctly at the first attempt. The mechanic must thoroughly understand the markings on the rule before he can read it correctly.

Divisions of a Mechanic's Rule

There are 12 inches in one foot; so a one-foot rule would have 12 equal spaces, but not 12 marks or dividing lines. The lines mark off the spaces. The spaces are called graduations. With a scale like this, as close as one inch could be measured. See Fig. 13.

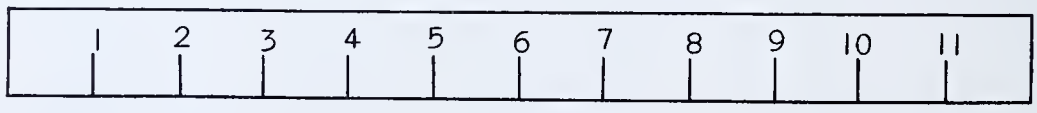


Fig. 13

How to Read a Rule

Size Description — Information Sheet No. 9

The markings on the rule show one graduation or division, which in this case is 1 inch. Of course, this rule would do all right to measure *even* inches, but anything less than one inch could not be measured. To overcome this objection, each division or graduation is marked off in half-inches. See Fig. 14.

HALF-INCH GRADUATIONS

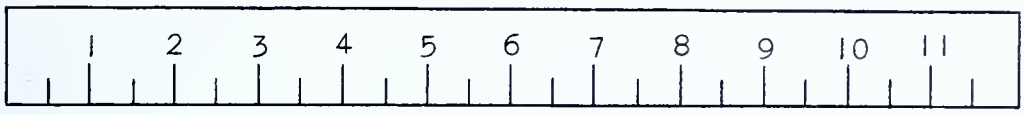


Fig. 14

Now the markings on the rule show two graduations or divisions of the same length in one inch. The rule may be used to measure as close as 1/2 inch. But the work has to be much closer than 1/2 inch. Therefore, the graduations or divisions must be made still finer. Fig. 15 shows about 2 inches of a mechanic's rule divided into small parts. Examine Fig. 15 carefully. It is plain that there are 16 spaces between the left-hand end of the rule and the mark numbered "1". Therefore, these graduations are each 1/16 of one inch long.

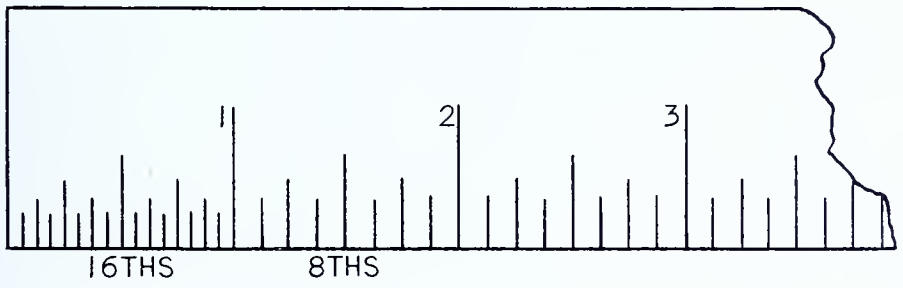


Fig. 15

The markings on the rule between the mark numbered "1" and the mark numbered "2" divide this inch into 8 parts. Therefore, these graduations are each 1/8 of an inch long. At the same time, it is plain that the longest marks divide the inch into halves, ($\frac{1}{2}$); the next longest marks divide the inch into quarters, ($\frac{1}{4}$); and so on down to the finest graduation.

GRADUATIONS IN ONE INCH

It should be clear that there are:

2 halves in one inch - each is read 1/2 inch.
4 quarters in one inch - each is read 1/4 inch.
8 eighths in one inch - each is read 1/8 inch.
16 sixteenths in one inch - each is read 1/16 inch.

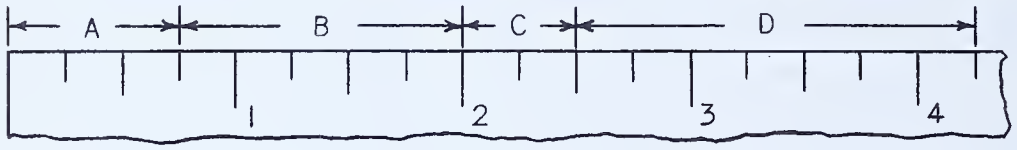
Notice that each division or graduation is just half of the one before and that the figure used to name the graduation is just twice as large as the one before. The finest measurement that may be taken with a rule divided or graduated as above is 1/16 of an inch.

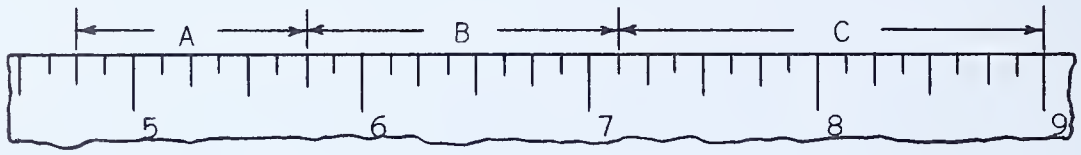
How to Read a Rule

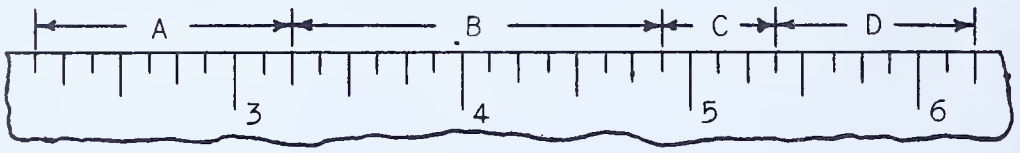
Size Description — Assignment Sheet No. 7

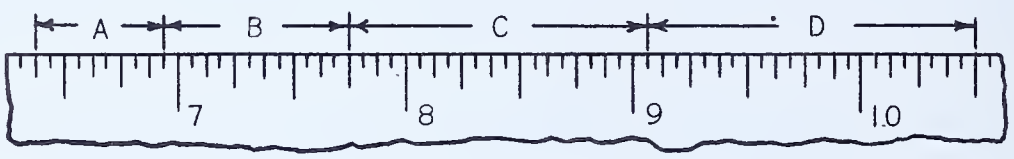
NAME — DATE — GRADE

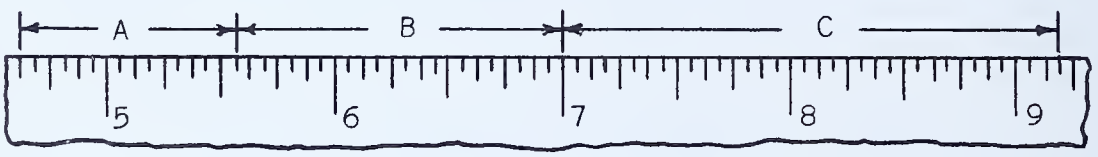
The dimensions between the arrowheads are to be placed in th corresponding circles at the right. DO NOT USE A RULE TO MEASURE.

1. 

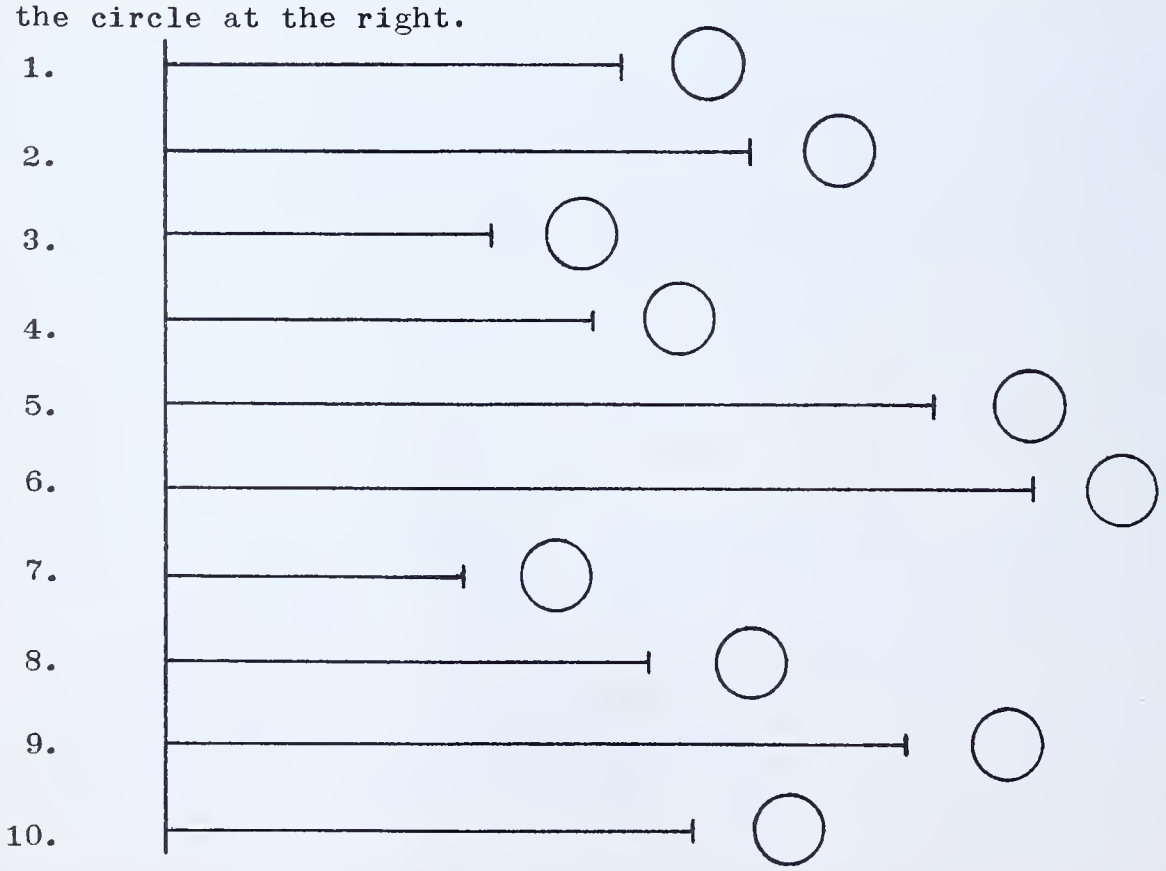
2. 

3. 

4. 

5. 

Measure with a rule the lengths of these lines from the long vertical line to the short vertical line. Place the correct figure in the circle at the right.



Size Description — Information Sheet No. 10

The shipfitter must know the size of an object as well as its shape. Size is shown on a drawing by the use of lines, arrowheads, figures, etc., such as are indicated in Figure 16. Notice both the weight and construction of the lines used in dimensioning and check these with the alphabet of lines given on page 2.

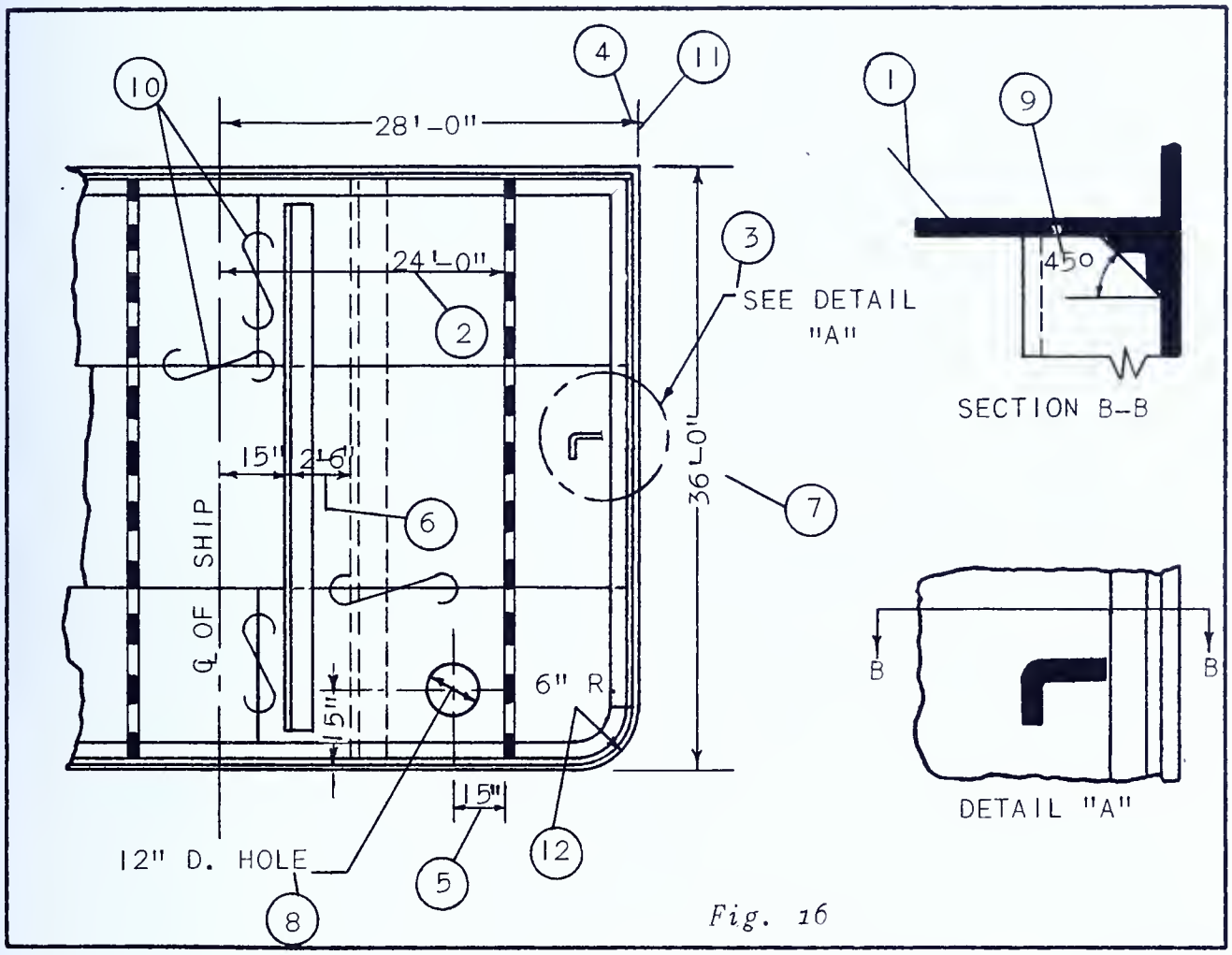


Fig. 16

DEFINITIONS

1. LEADER - Refers a note to some part of the drawing.
2. DIMENSION LINE - Carries figure denoting size - has arrowheads at ends.
3. NOTE - Explanation in English.
4. EXTENSION LINE - Refers dimension to point on drawing.
5. DIMENSION - Size of part or its location.
6. DETAIL DIMENSION - Size of part or its location.
7. OVERALL DIMENSION - Size over all (not just a part).
8. LOCATION DIMENSION - Tells where something is.
9. ANGLE DIMENSION - Indicates the degree of angle.
10. MARK FOR SEAM OR BUTT - Where two plates meet.
11. ARROWHEAD - Indicates the end of a dimension line.
12. RADIUS DIMENSION - Radius of an arc or circle.

Rules for Dimensioning

1. The best rule is to place the dimensions where the mechanic can find them most readily.
2. The plan view should have the most dimensions.
3. Dimensions are usually best outside or between views unless clearer on the view. Do not crowd them.
4. Make a distinction in weight between the dimension lines and edge lines. See Fig. 16.
5. Give the length, width, and height of all parts of the object.
6. Horizontal dimensions should be indicated horizontally (i.e., read without turning the drawing), and vertical dimensions, vertically (i.e., read by turning the right edge of the drawing to the bottom).
7. Holes are usually dimensioned by note. See Fig. 16.
8. Angles are dimensioned with the arc of a circle. See Fig. 16.
9. Place the letter "R" after all radius dimensions.
10. Complicated objects are made up of simple shapes which can be dimensioned by the rules given here. All we need in addition is a location dimension. This should be from center to center or from some reasonable base line, such as a finished surface.
11. Do not repeat dimensions unless there is a good reason for it. Do not add unnecessary dimensions.
12. Never use a center line or edge line as a dimension line.
13. The side view of cylindrical objects is usually the best view on which to show diameters.
14. Notes should read horizontally if possible.

Scale of Drawings

When small objects are drawn by the draftsman exactly to size the drawing is full scale or 12" = 1 ft. Large objects are drawn in reduced size, and very small objects are increased in size on the drawing. The dimensions placed on the drawing, however, are always the full size dimensions of the object. Scales commonly used in reduction of size on hull drawings are 1" = 1'-0"; ½" = 1'-0"; ¼" = 1'-0". The title of the drawing usually tells to what scale the drawing has been made.

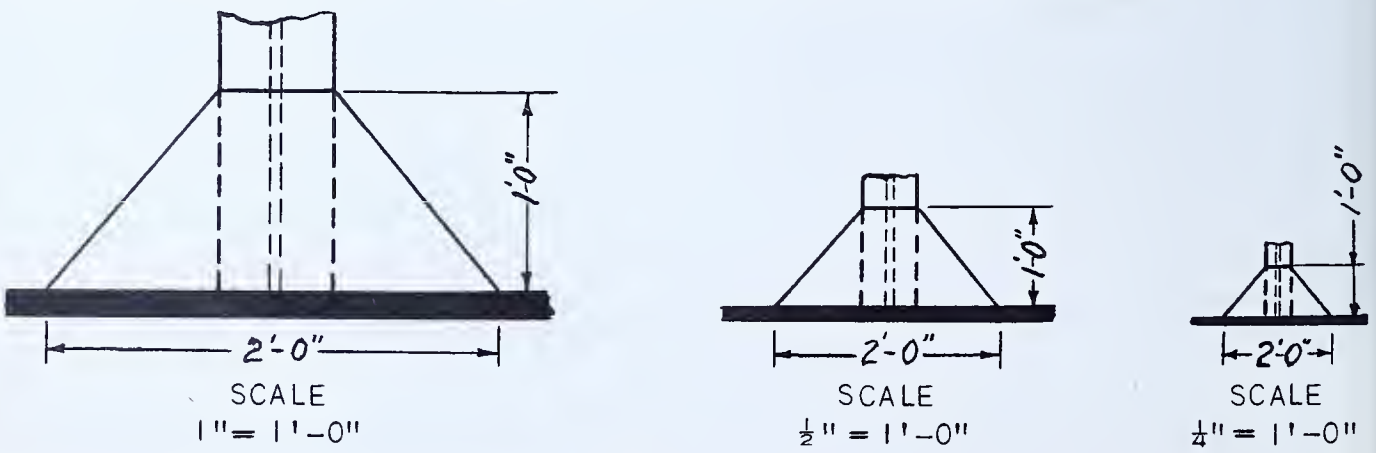


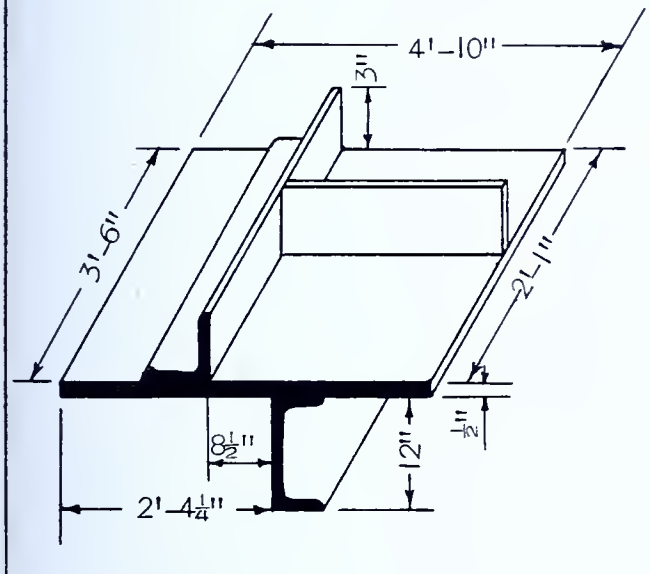
Fig. 17

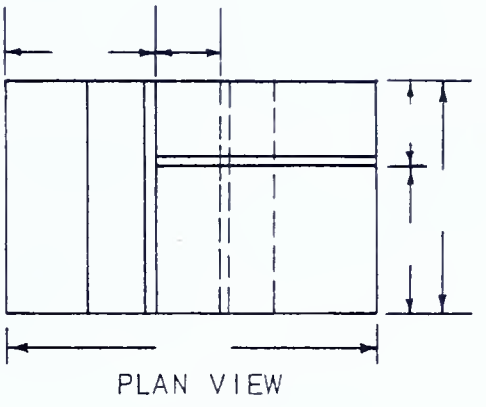
Dimensioning

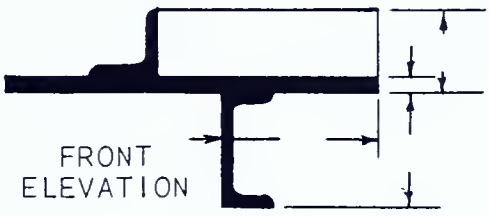
Size Description — Assignment Sheet No. 8

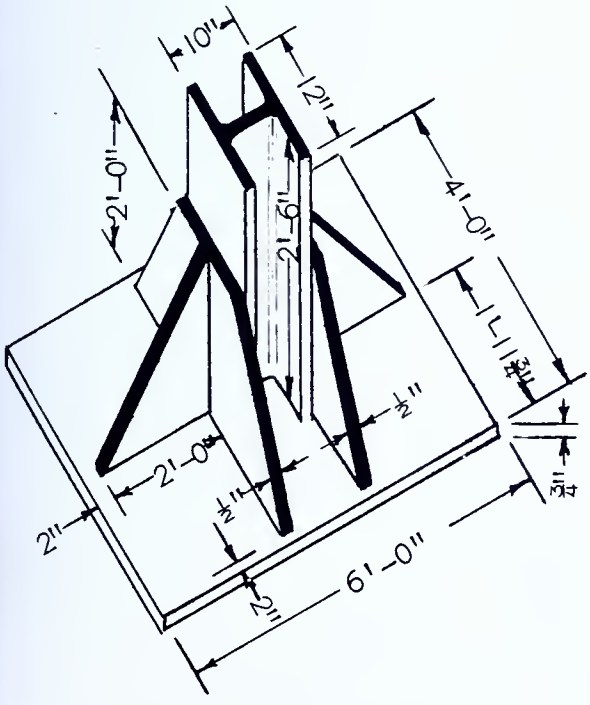
NAME — DATE — GRADE

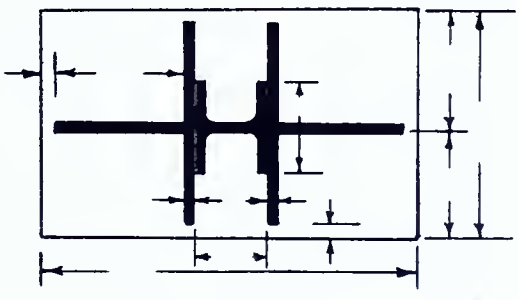
Insert the dimensions where indicated on the plan and elevation views. It may be necessary to determine some dimensions by adding or subtracting dimensions given on the picture drawing.

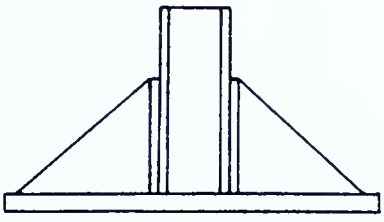






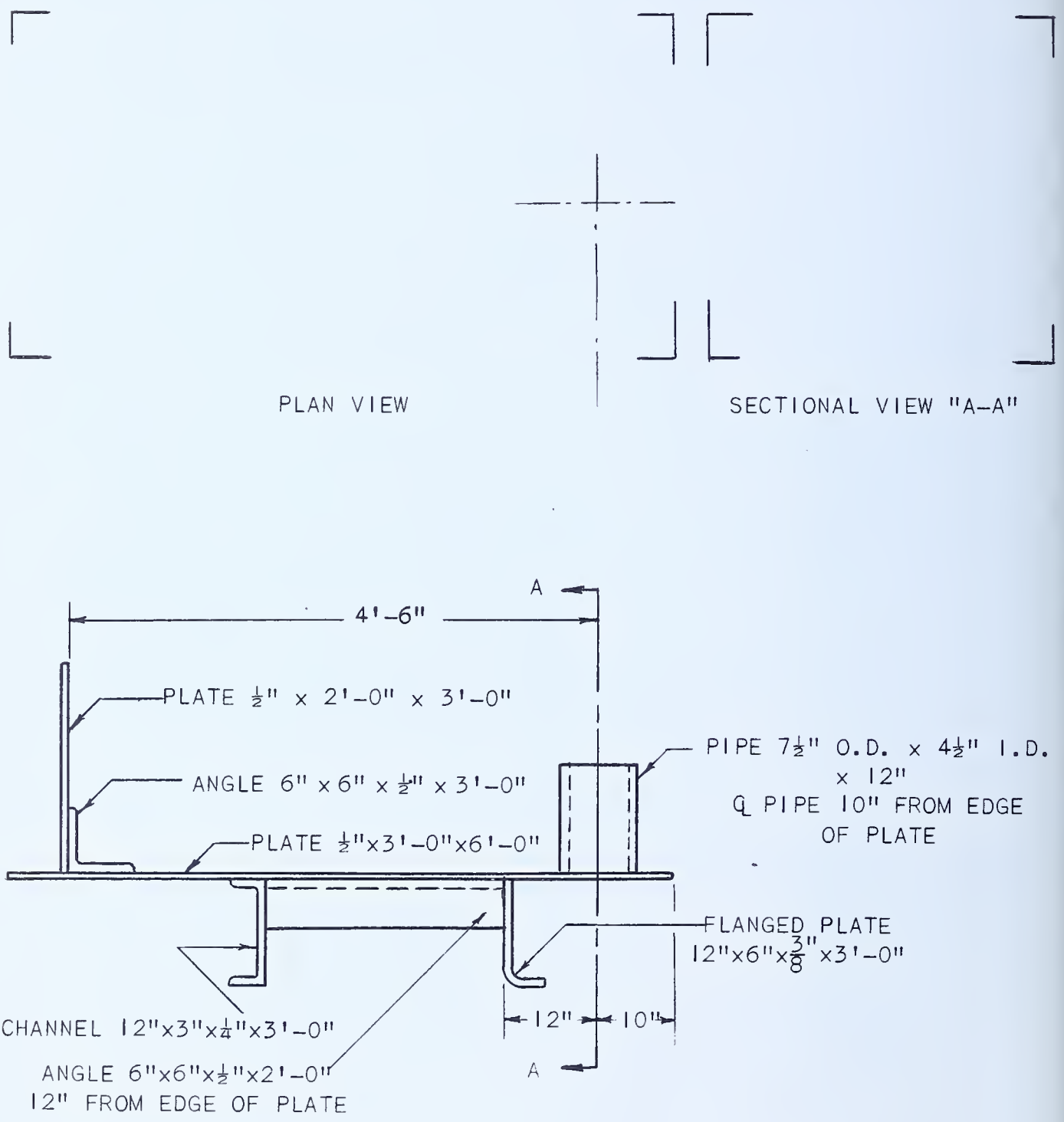






Dimensioning

Size Description — Assignment Sheet No. 8



1. Complete the plan view and give dimensions required.

2. Complete the sectional view.

PART III

INFORMATION CONCERNING THE READING OF SHIP HULL PRINTS

Terms and Definitions Pertaining to Lines of a Ship

Ship Hull Prints — Information Sheet No. 11

Every shipfitter should be familiar with the technical names denoting ship lines, surfaces, and dimensions. Familiarity with these terms is essential in reading blueprints and in building and installing parts of a ship. Refer to Figs. 18 and 19 while studying these lines.

BASE LINE - A level, horizontal line at the bottom of the ship from which all vertical heights are measured.

WATER LINE - Any line parallel to the base line used for regulating and setting a ship.

CENTER LINE - A straight line running from *bow* to *stern* midway between the sides of the ship, from which all transverse horizontal dimensions are taken.

BUTTOCK - A straight line running parallel to and at specified distances from the center line of the ship, such as 4'-0", 8'-0", 12'-0", etc., used for regulating and setting a ship.

FRAME LINES - Lines running across the ship from port to starboard at given spaces perpendicular to the center line and base line.

FRAME SPACING - The distance between frame lines.

SIDE LINES - A straight, vertical line at the widest moulded surface of the ship or at midship.

DEAD RISE or RISE LINE - The rise of the bottom of the ship at midship from the half siding to a given height at the side line.

HALF SIDING - For Welded Ships - The distance from center line to the knuckle of the flat keel.

PROFILE - A view looking at the side of the ship. The lines plan shows buttock lines as curved lines where they contact the moulded surface. The profile view also shows the sheer of the deck.

BODY PLAN - A plan showing the shapes of the frames as they contact the moulded surface of the shell, and showing the water lines and buttocks as straight lines. In this plan are also shown all decks, stringers, sight edges of shell plating, inner bottom, and practically all members in the hull construction. This plan consists of a forward plan and an after plan. The forward plan is a view standing to starboard at midship looking forward, or standing to port at the forward end looking aft. The after plan is a view standing to starboard at midship looking aft, or standing to port at after end and looking forward. This plan is essential for the development of all working drawings and jobs.

Terms and Definitions Pertaining to Lines of a Ship

Ship Hull Prints — Information Sheet No. 11

LOAD WATER LINE - L.W.L. - The water line at which the ship will float when loaded to its designed draft.

FORWARD PERPENDICULAR - F.P. - A vertical line at the point where the load water line crosses the foremost part of the moulded surface.

AFTER PERPENDICULAR - A.P. - A vertical line taken at the after end of the rudder post. If there is no rudder post, it is taken at the center of the rudder stock.

LENGTH BETWEEN PERPENDICULARS - L.B.P. - The distance from the forward perpendicular to the after perpendicular. The amount of power needed to drive the ship depends largely on the designed length of the ship.

LENGTH OVER ALL - L.O.A. - The total length of the ship from end to end, including the bow and stern overhangs.

MIDSHIP SECTION - A transverse section exactly half way between the F.P. and the A.P. Almost invariably this is the widest part of the ship.

PARALLEL MIDDLE BODY - The straight part at the center of the ship where the water lines and buttocks have no curvature; that is, where all the fore and aft lines are parallel.

BEAM - The moulded width of the ship at the widest point.

DEPTH - The height of the ship at the midship section from the base line to the moulded line of deck.

DRAFT (Moulded) - The height from the base line to the load water line.

FREEBOARD - The height from the load water line to the underside of the ship.

CAMBER - The transverse curvature or round-up.

It is the difference in height between the deck at the side and the deck at the center line. The camber curve may be a curved line, or a number of straight lines.

SHEER - The curvature of the deck longitudinally as shown in profile. It is the difference in height between the decks at midship and the ends of the ship.

MOULDED LINES - or SURFACES - The inside surface of the skin, or plating, of a ship. The moulded surface has no thickness, and is fair and smooth.

Actually when the ship has been built, the thickness of the plating will extend outside of the moulded surface. "Outside" strakes of plating do not touch the moulded surface if they have a liner against the shell frame. The *heel* of each shell frame is in this moulded surface (unless joggled). It should be remembered that this moulded surface is not an actual part of the ship. It is almost exactly the shape which a thin piece of sheet rubber would take if stretched tightly over the shell frames and main deck beams with no plating in place.

HALF-BREADTH or WATER LINE PLAN - A view looking down on the moulded surface. Here the frame lines and buttocks appear straight, while the water lines show their true shape. To save space, only the port side is shown.

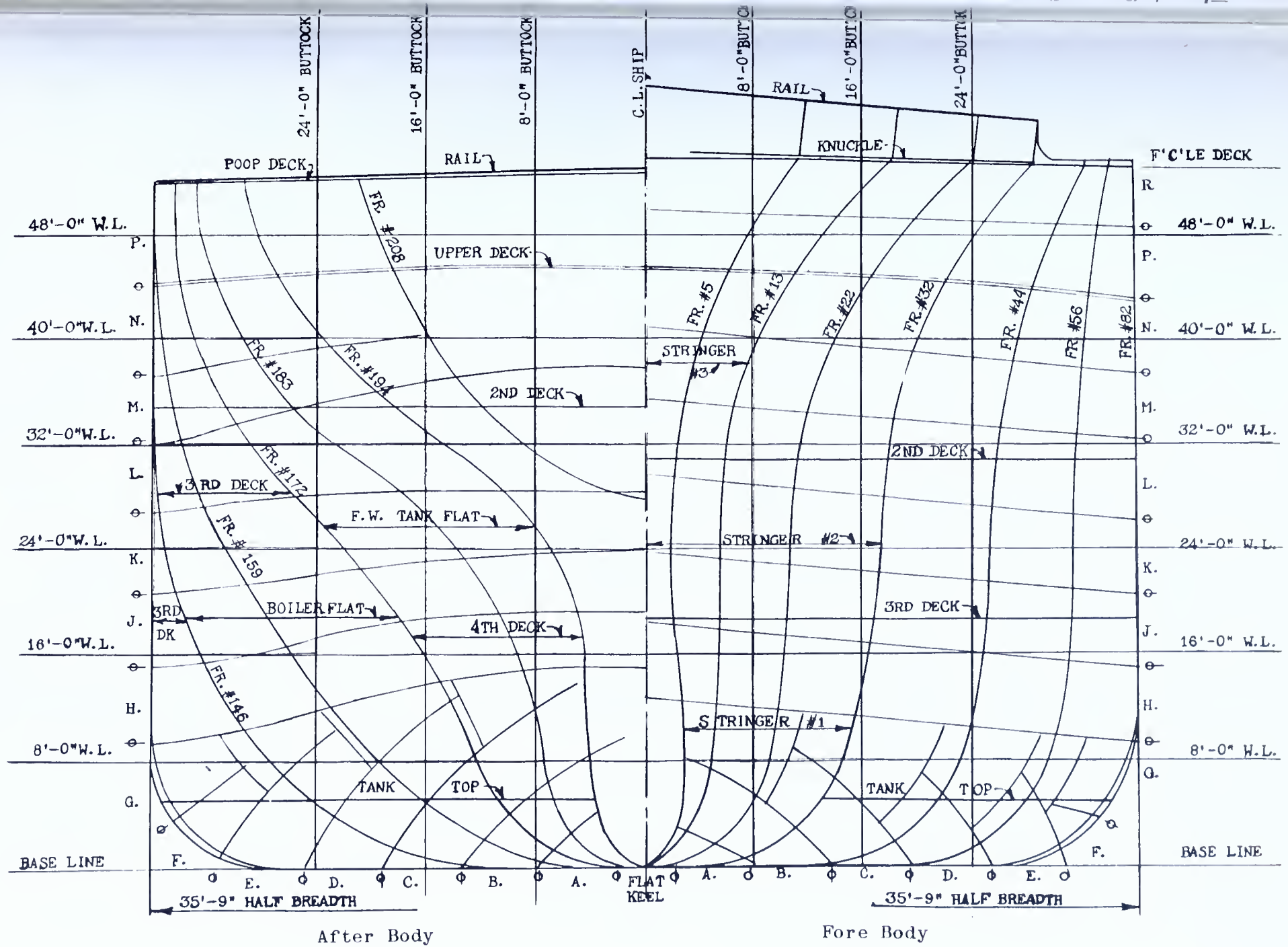


FIG. 18 - BODY PLAN

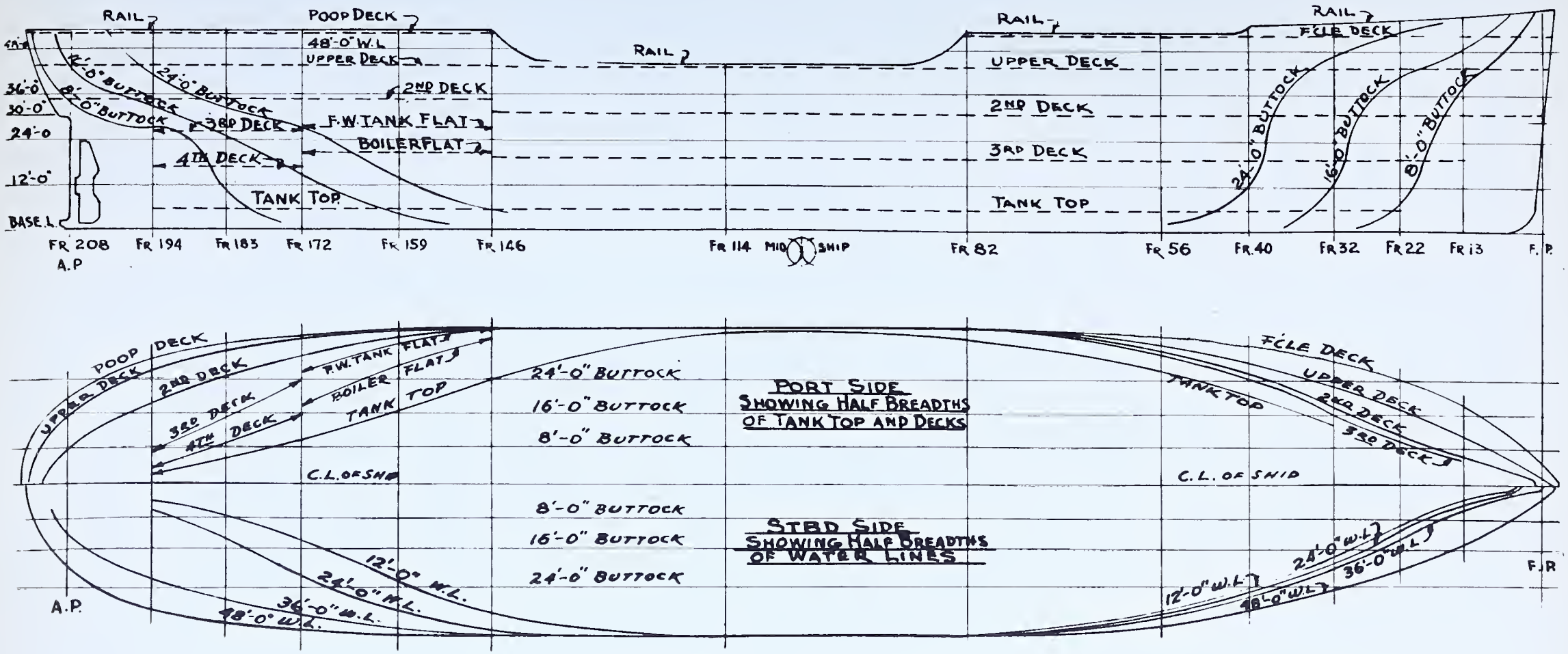


FIG. 19 - LINES PLAN

Terms and Definitions Pertaining to Lines of a Ship

Ship Hull Prints — Assignment Sheet No. 9

NAME — DATE — GRADE

Identify the following definitions by placing the correct term in the space provided for this purpose.

	DEFINITIONS	TERM
1.	A level, horizontal line at the bottom of a ship from which all vertical heights are measured.	1.
2.	Lines running across a ship from port to starboard at given spaces.	2.
3.	A straight, vertical line running from bow to stern midway between the sides of a ship.	3.
4.	A water line at which a ship will float when loaded to its designed draft.	4.
5.	A straight, vertical line running parallel to and at specified distances from the center line of the ship.	5.
6.	Any line parallel to the base line.	6.
7.	A vertical line at the point where the load water line crosses the foremost part of the moulded surface.	7.
8.	The height of the ship from the base line to the moulded line of deck at midship.	8.
9.	The curvature of the deck longitudinally, as shown in a profile.	9.
10.	The inside surface of the skin, or plating, of a ship.	10.

The thickness of plates and shapes used in shipbuilding is expressed on blueprints in pounds per square foot. For example, a plate thickness may be expressed as 40.8 pounds, which, expressed in inches, is a one-inch plate. When reading a blueprint, a shipfitter should be able to determine the thickness in inches of a plate or shape when the thickness is expressed in pounds per square foot.

THICKNESS OF PLATE

The common plate thicknesses can be determined readily by remembering that the weight of plate per square foot increases 5.1 pounds for every 1/8" increase in thickness. For example, a plate 1/8" thick will weigh 5.1 pounds per square foot, and a plate $\frac{1}{4}$" thick will weigh 10.2 pounds per square foot. A table of the weights of plates may be found by referring to Appendix II.

From time to time it may be necessary for a shipfitter to calculate the thickness of a plate when the weight is expressed in pounds per square foot. The weight of a plate 1/16" thick is 2.55 pounds per square foot. Since a square foot of plate 1/16" thick weighs 2.55 pounds, divide this weight into the weight per square foot of the plate to be determined. The answer will be expressed as plate thickness in sixteenths of an inch.

Example: Find the thickness of a 17.85 pound plate.

Solution: 17.85 ÷ 2.55 = 7 or 7/16".

THICKNESS OF ANGLE

The size of an angle may be expressed as 6" x 4" x 17.9# x 27'-6". The first two numbers in the series are the width of the flanges. The third number, 17.9#, represents the thickness of the angle expressed in pounds. The last number in the series, 27'-0", represents the length of the angle.

The thickness of this angle may be determined by referring to the table on the size of angles in Appendix II. However, it may be necessary to calculate this thickness if a table is not available. To calculate the thickness of an angle in sixteenths of an inch, use the following formula:

$$T = \frac{5W}{F_1 + F_2}$$

T = Thickness of the angle in sixteenths of an inch.

W = Weight of angle.

F_1= Width of one flange.

F_2= Width of other flange.

Example: What is the thickness of an angle having flanges of 6" and 4" widths, weighing 16.2 pounds per lineal inch?

Solution: $T = \dfrac{5W}{F_1 + F_2}$

$$T = \frac{5 \times 16.2}{6 + 4}$$

$$T = \frac{81.0}{10} = 8.1 = 8/16 \text{ or } \tfrac{1}{2}\text{" angle}$$

Sizes of Plates and Shapes

Ship Hull Prints — Assignment Sheet No. 10

NAME — DATE — GRADE

1. Calculate the thickness of a 7.65 pound plate.

   Solution -

   Answer

2. Calculate the thickness of a 12.75 pound plate.

   Solution -

   Answer

3. Calculate the thickness of a 22.95 pound plate.

   Solution -

   Answer

4. Calculate the thickness of a 28.05 pound plate.

   Solution -

   Answer

5. Calculate the thickness of a 33.2 pound plate.

   Solution -

Answer

6. Calculate the thickness of an angle 8" x 8" x 38.9 .
   Solution -

Answer

---

7. Calculate the thickness of an angle 4" x 4" x 15.7 .
   Solution -

Answer

---

8. Calculate the thickness of an angle 3" x 3" x 9.4 .
   Solution -

Answer

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9. Calculate the thickness of an angle 7" x 4" x 26.2 .
   Solution -

Answer

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10. Calculate the thickness of an angle $3\frac{1}{2}$" x $3\frac{1}{2}$" x 13.6 .
    Solution -

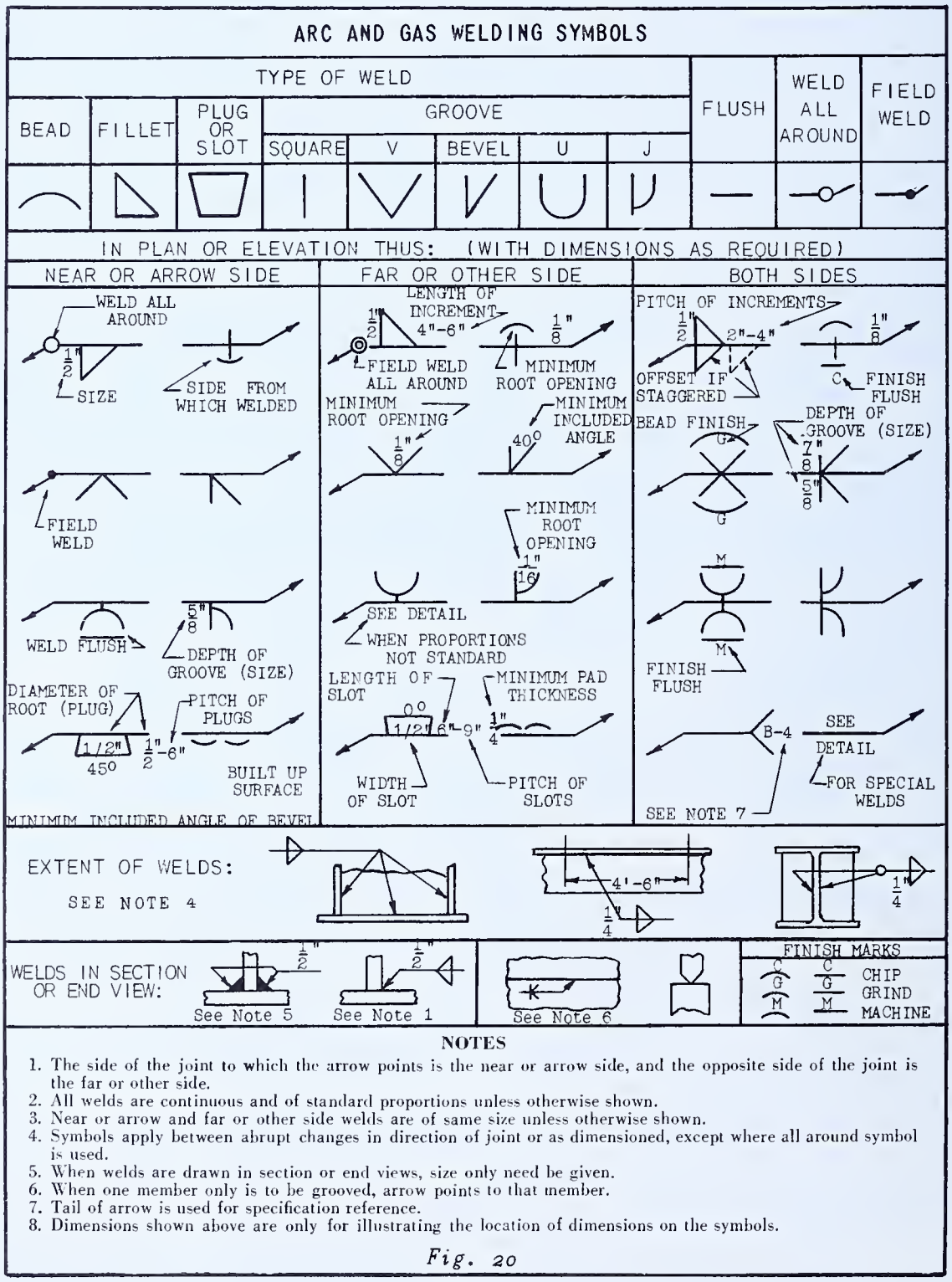
Answer

Arc and Gas Welding Symbols

Ship Hull Prints **Information Sheet No. 13**

Most shipyards use the following list of symbols on blueprints to denote certain types of welds. Other shipyards may indicate the type weld in the blueprint side material or by noting the type of weld at the point of welding. The symbols represented below are standard, being used with little variation in most shipyards throughout the country.

Welding abbreviations used on blueprints may be found by referring to Appendix I.



NOTES

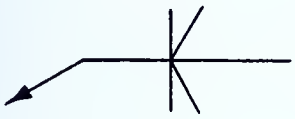
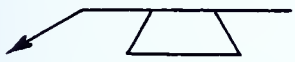
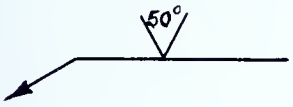
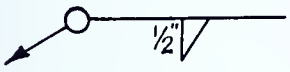
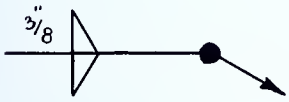
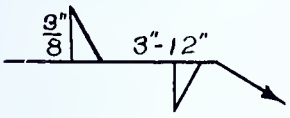
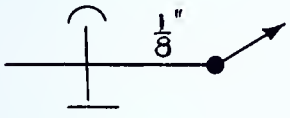
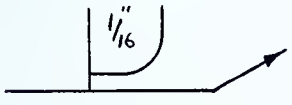
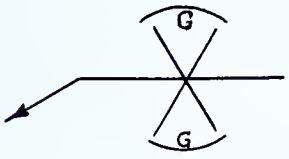
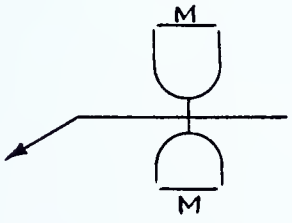
1. The side of the joint to which the arrow points is the near or arrow side, and the opposite side of the joint is the far or other side.
2. All welds are continuous and of standard proportions unless otherwise shown.
3. Near or arrow and far or other side welds are of same size unless otherwise shown.
4. Symbols apply between abrupt changes in direction of joint or as dimensioned, except where all around symbol is used.
5. When welds are drawn in section or end views, size only need be given.
6. When one member only is to be grooved, arrow points to that member.
7. Tail of arrow is used for specification reference.
8. Dimensions shown above are only for illustrating the location of dimensions on the symbols.

Fig. 20

Ship Hull Prints — Assignment Sheet No. 11

NAME — DATE — GRADE

Explain in detail the meaning of the following welding symbols.

	SYMBOL	ANSWER
1.		1.
2.		2.
3.		3.
4.		4.
5.		5.
6.		6.
7.		7.
8.		8.
9.		9.
10.		10.

PART IV

SHIP HULL PRINTS

List of Ship Hull Prints

Print No. 1 - Transverse Bulkhead

" No. 2 - Shell Expansion (Cargo)

" No. 3 - Transverse Section, Looking Forward

" No. 4 - Sheer

" No. 5 - Camber

" No. 6 - Midship Camber

" No. 7 - Pocket Cutouts

" No. 8 - Brackets and Liners

" No. 9 - Brackets Welded to Deck

" No. 10 - Frame Spacing

" No. 11 - Ordinary Frames and Beams

" No. 12 - Hatch End Frames and Beams

" No. 13 - Center Keel and Longitudinal Girders

" No. 14 - Floors

" No. 15 - Tank Top and Pipe Tunnel

" No. 16 - Upper Deck Plan

" No. 17 - Longitudinal Girders 22'-6" Off Center Line

" No. 18 - Transverse Bulkhead #114

" No. 19 - Shell Expansion

" No. 20 - Bilge Section (Riveted)

" No. 21 - Side Frames (Riveted)

" No. 22 - Upper Deck Plating (Riveted)

" No. 23 - Section of Engine Casing

" No. 24 - Frames

" No. 25 - Transverse Bulkhead 114

Ship Hull Prints — Information Sheet No. 14

The following general facts concerning the making of drawings will aid the student of blueprint reading to interpret prints:

1. Working drawings of ships seldom show the entire plan, since port and starboard plans are identical. For example, a drawing or plan view of a deck is drawn showing only half of the deck with the center line toward the bottom of the print.

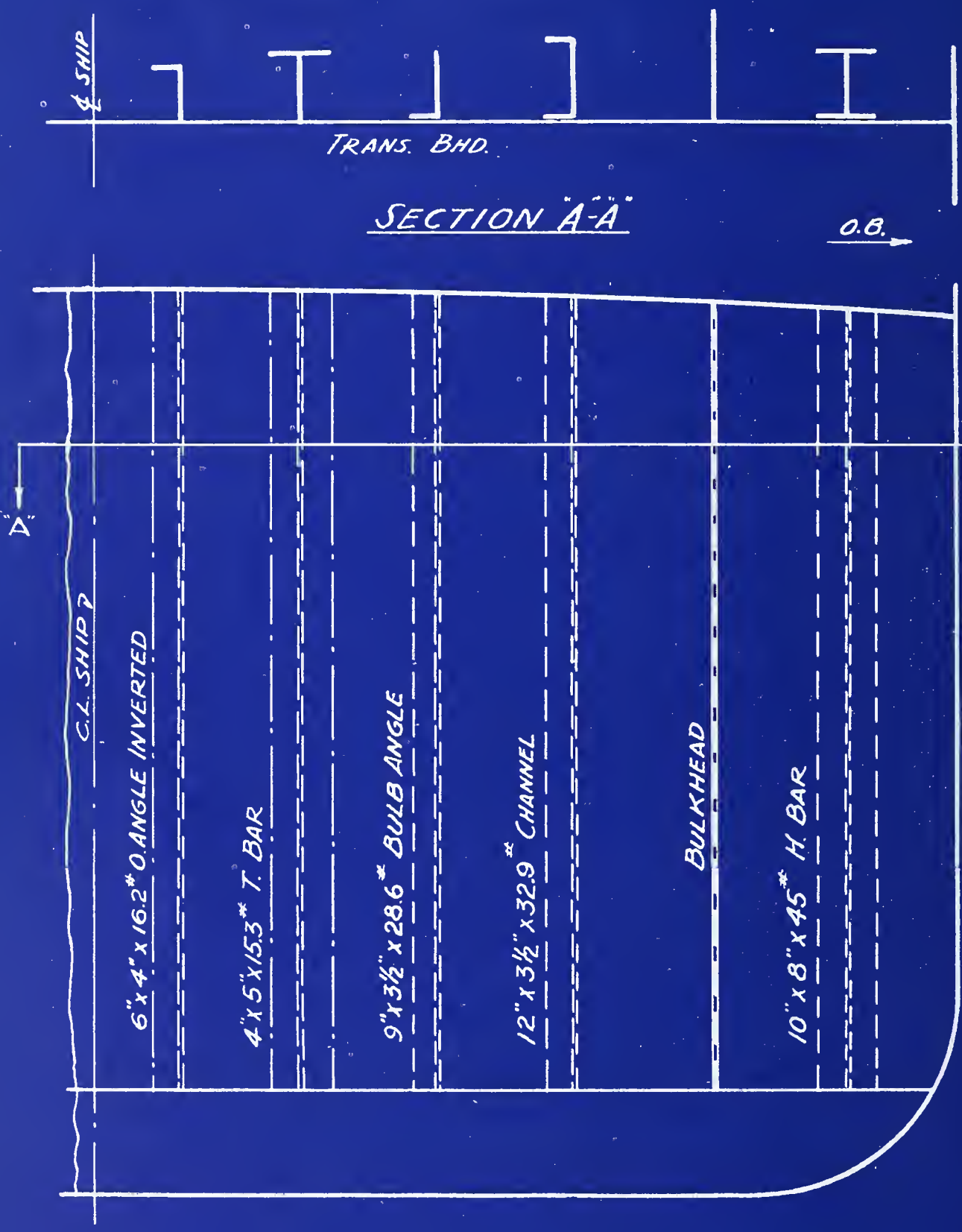
2. The forward end of the ship is usually toward the right hand side of the drawing.

3. Forward sections are usually drawn starboard looking forward.

4. After sections are usually drawn port side looking aft.

5. Frames are numbered from either the forward end or after end.

6. It is important that a shipfitter refer to the side material on the blueprint. Information concerning title, alterations, general information, bill of material, and other notes may be found to be extremely important. Therefore, always read the side material carefully on the prints when reading the working drawing.



TRANSVERSE BULKHEAD
PORT LOOKING AFT
ALL STIFFENERS ON FAR SIDE

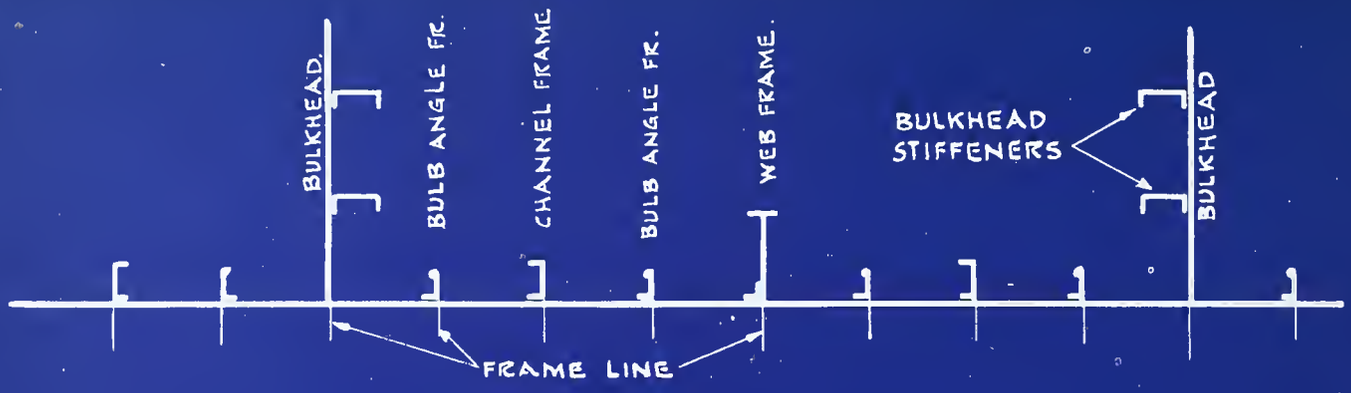
PRINT NO. 1

Ship Hull Prints — Assignment Sheet

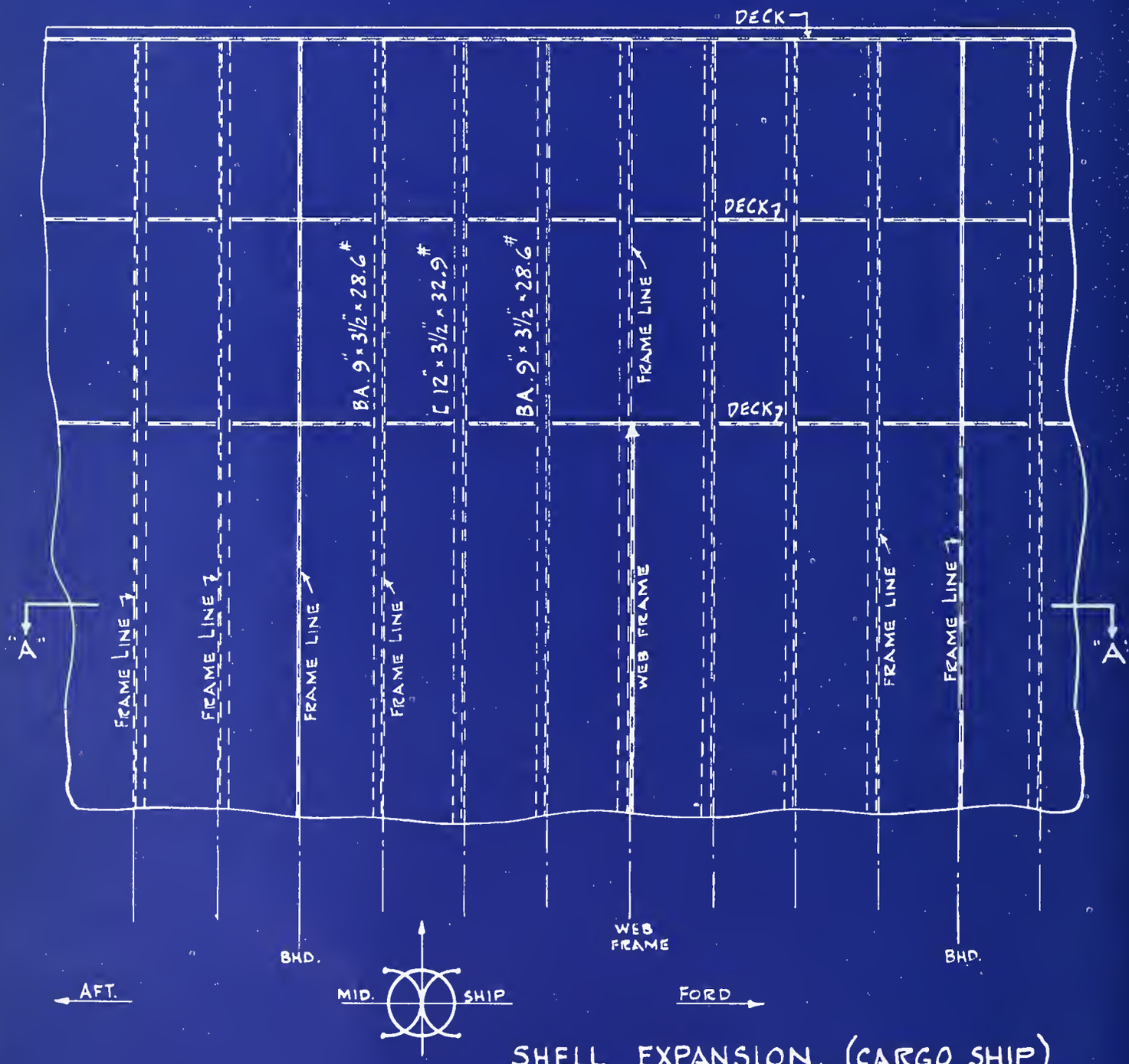
NAME _____ DATE _____ GRADE _____

Section of Transverse Bulkhead
Print No. 1

	QUESTIONS	ANSWERS
1.	What view is represented by section "A-A"?	1.
2.	Does a transverse bulkhead extend longitudinally or athwartship?	2.
3.	How thick is "o" angle 6" x 4" x 16.2 lbs.?	3.
4.	How thick is bulb angle 9" x 3½" x 28.6 lbs.?	4.
5.	How thick is the channel 12" x 3½" x 32.9 lbs.?	5.
6.	On which side of the transverse bulkhead is the longitudinal bulkhead shown?	6.
7.	What is meant by the abbreviation "O.B."?	7.
8.	What is an inverted angle?	8.



SECTION AT "A"-"A"



SHELL EXPANSION. (CARGO SHIP)

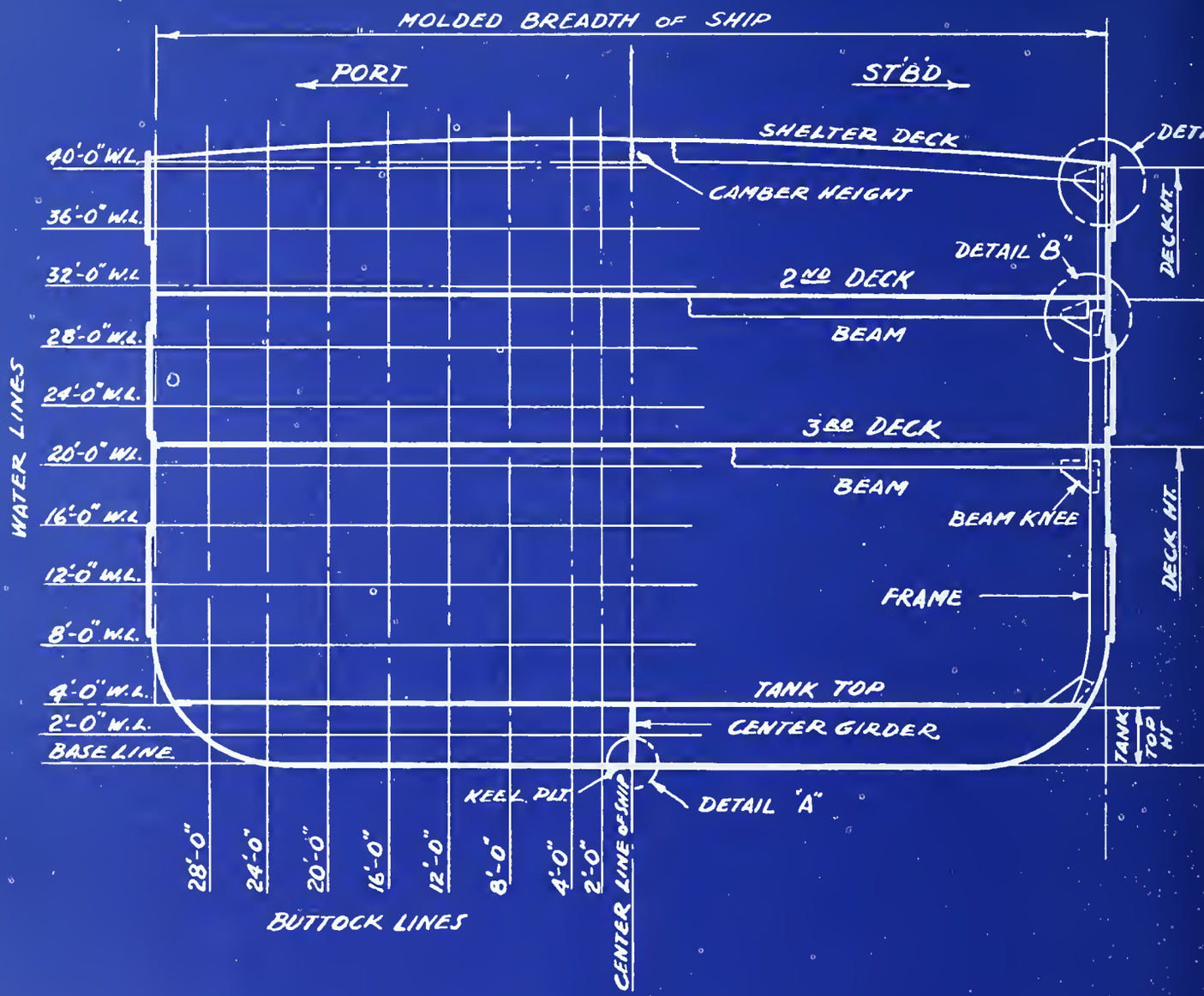
NOTE :- OIL TANKERS DO NOT ALWAYS HOLD TO THE CHANGE OF FRAMES AT MID ℄ SHIP. USUALLY THE FRAME LINE IS ON THE SAME SIDE FOR ALL OF THE OIL TANK SPACES.

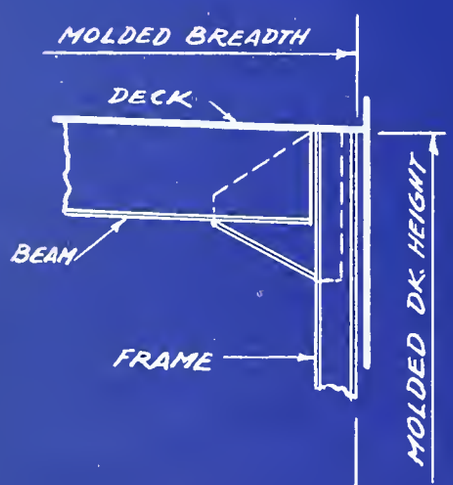
Ship Hull Prints — Assignment Sheet

NAME — DATE — GRADE

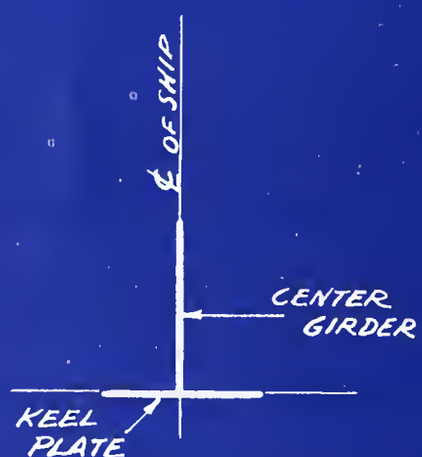
Shell Elevation (Cargo Ship)
Print No. 2

QUESTIONS	ANSWERS
1. The frame line is on which side of the after bulkhead?	1.
2. The frame line is on which side of the forward bulkhead?	2.
3. The frame line is on which side of the web frame?	3.
4. Where is the molded line of deck?	4.
5. Where is the molded line of tank top?	5.
6. The frames and bulkheads are on which side of the shell?	6.
7. How would you know on which side of the shell the bulkheads and frames are located if section "AA" were not shown?	7.
8. What is meant by shell expansion?	8.

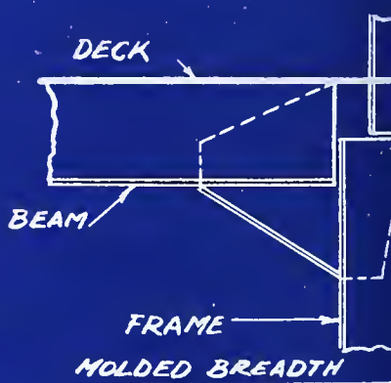




DETAIL "C"



DETAIL "A"



DETAIL

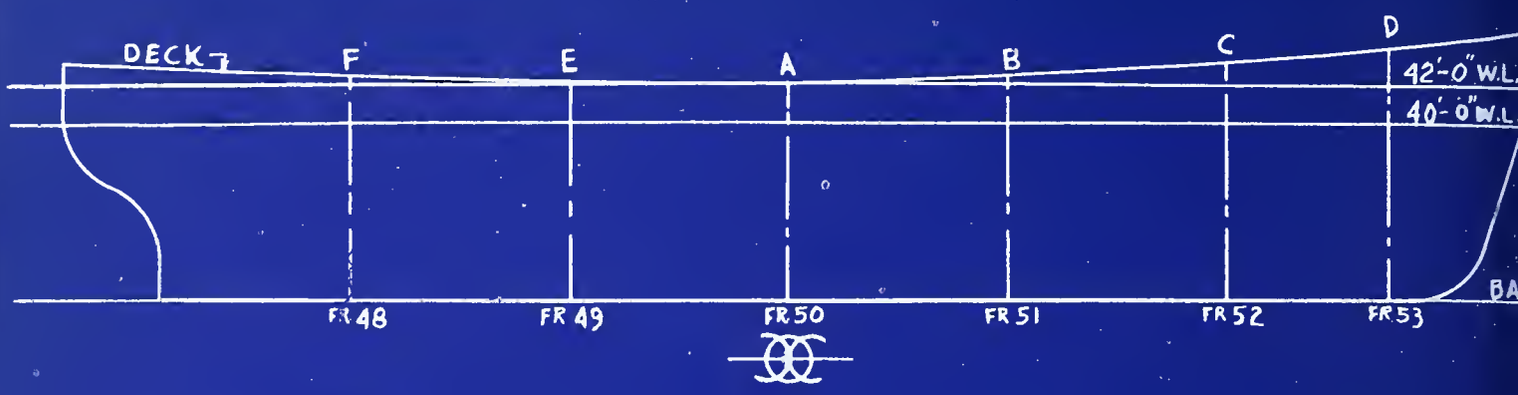
TRANSVERSE SECTION
LOOKING FORWARD

Ship Hull Prints — Assignment Sheet

NAME _____ DATE _____ GRADE _____

Transverse Section Looking Forward
Print No. 3

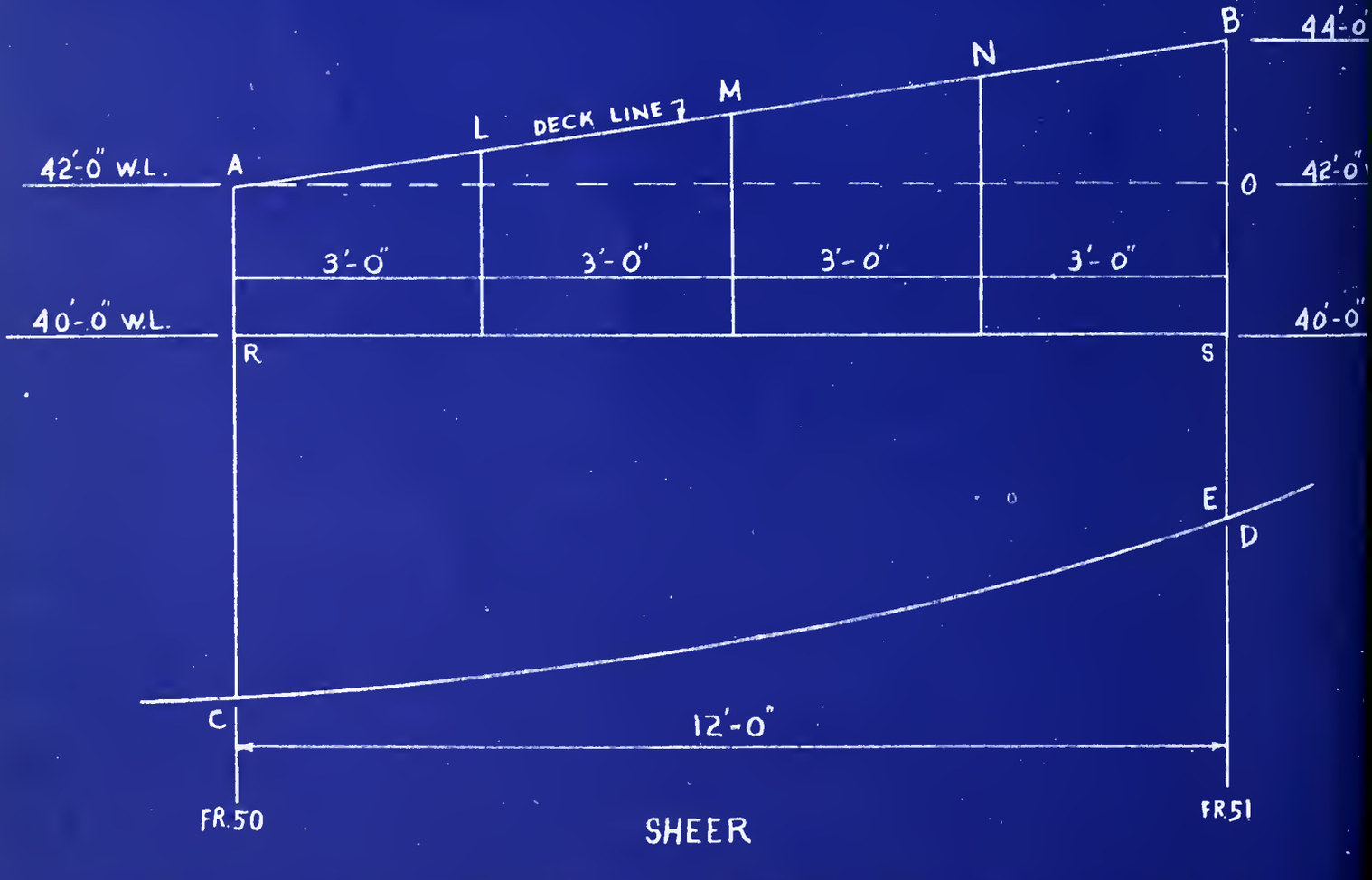
QUESTIONS	ANSWERS
1. What water line is nearest to the second deck?	1. _____
2. What is the distance from the center line to the nearest buttock line?	2. _____
3. What is the distance from the base line to the tank top?	3. _____
4. Which deck has camber?	4. _____
5. What is a transverse section?	5. _____
6. Why are details "A","B",and "C" shown?	6. _____
7. Explain molded breadth of the ship.	7. _____
8. Explain molded depth of the ship.	8. _____



CURVED SHEER.

KNUCKLE SHEER

NO SHEER



SHEER

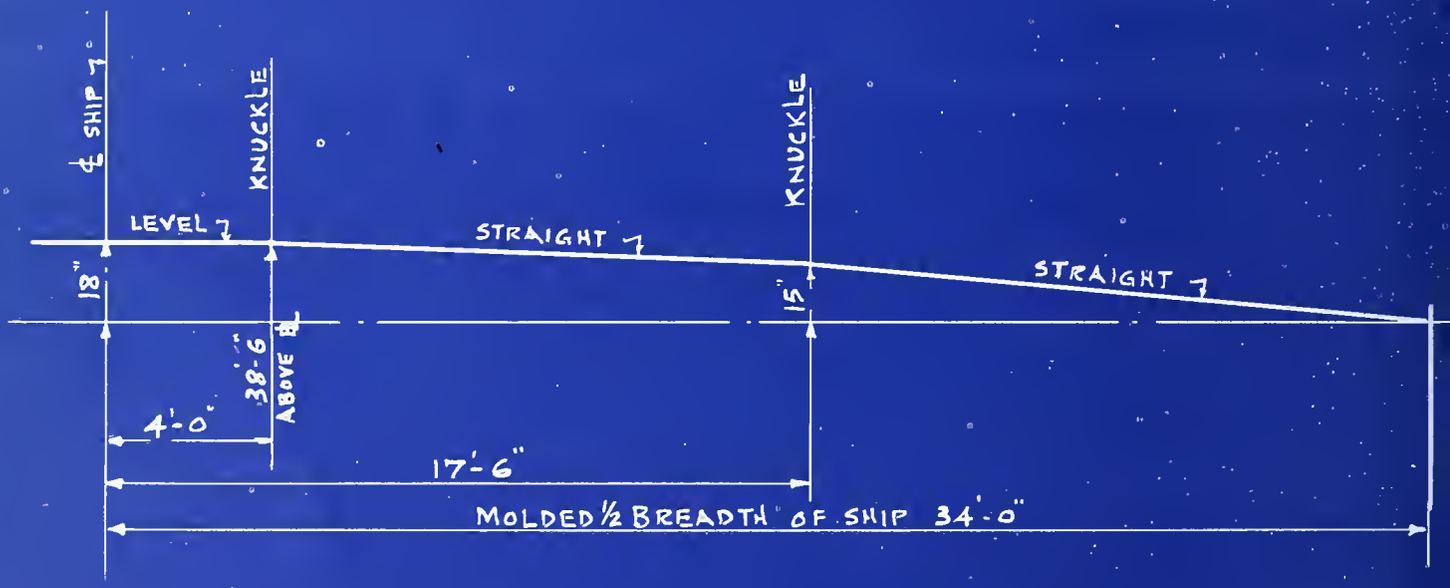
Ship Hull Prints — Assignment Sheet

NAME DATE GRADE

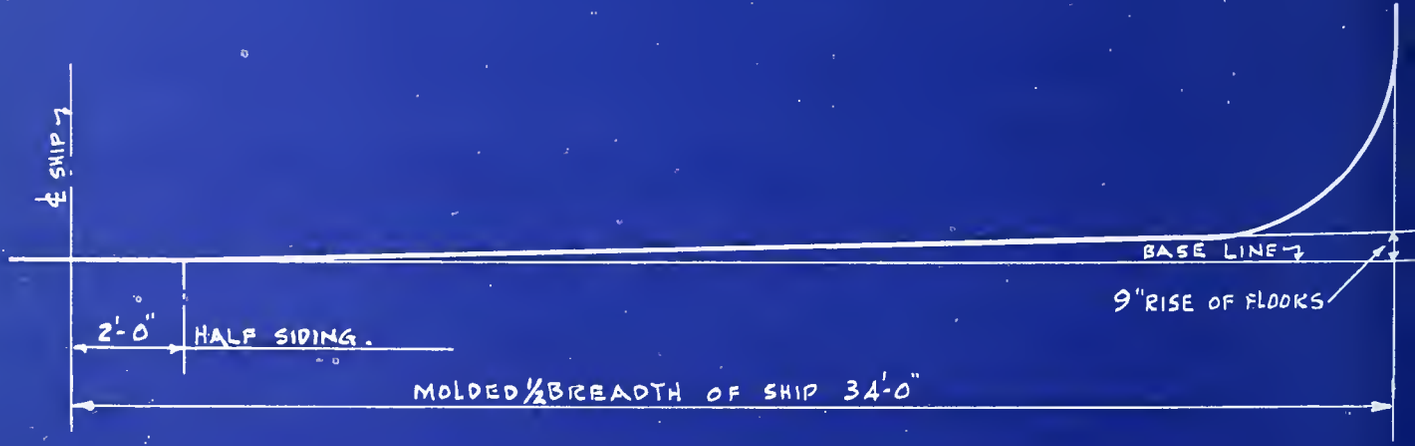
Sheer
Print No. 4

QUESTIONS	ANSWERS
1. What is the frame spacing between frames fifty and fifty-one?	1.
2. What is the height of the sheer between fifty and fifty-one?	2.
3. What is the height of the sheer at point "M"?	3.
4. What is the height of the ship from the base line to the lowest part of the upper deck?	4.
5. What is the frame number at midship?	5.
6. What is meant by the term "sheer"?	6.
7. How does knuckle sheer differ from curved sheer?	7.

CURVED OR NORMAL CAMBER.



KNUCKLE CAMBER



HALF SIDING & RISE OF FLOORS.

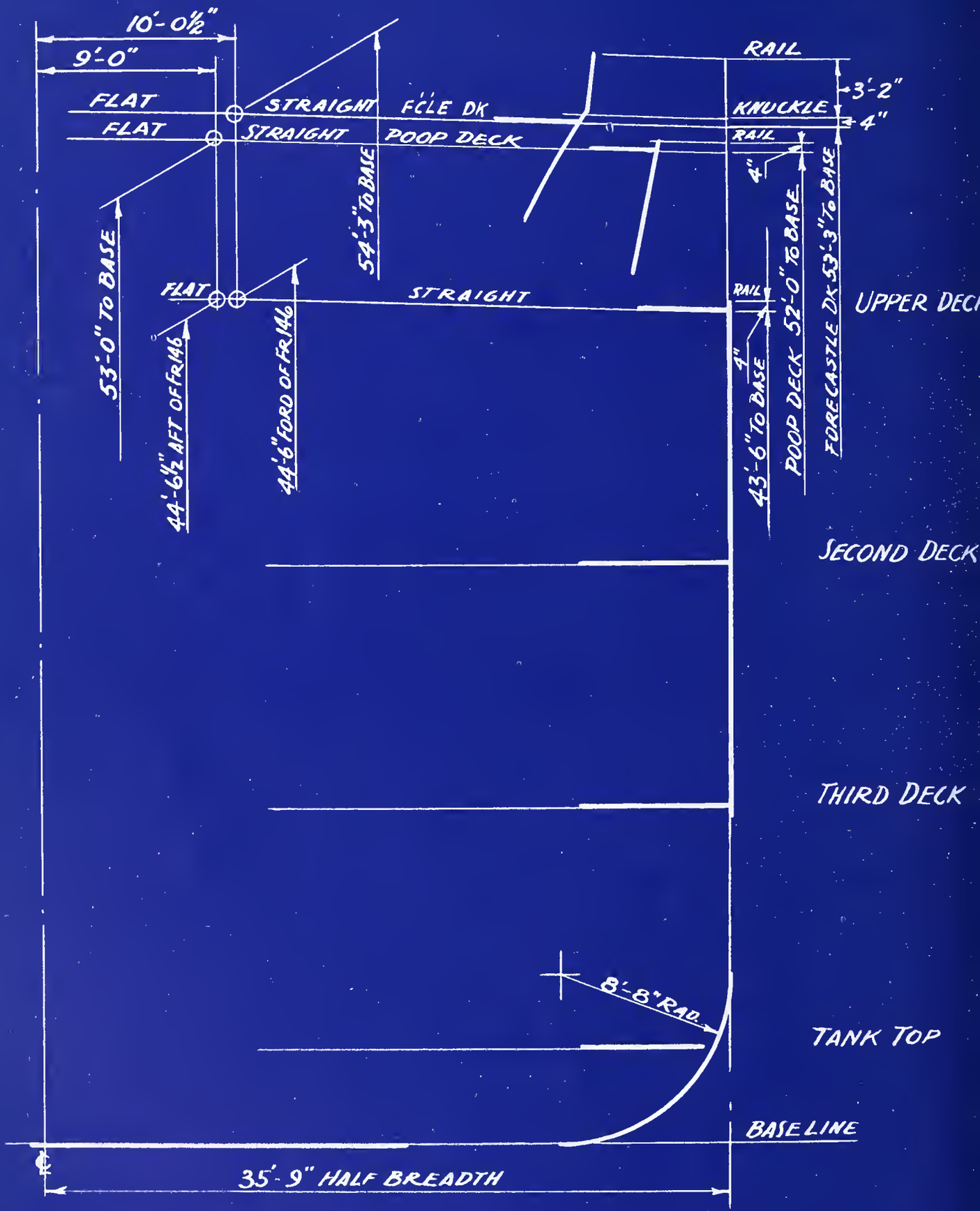
PRINT NO. 5

Ship Hull Prints — Assignment Sheet

NAME — DATE — GRADE

Camber
Print No. 5

QUESTIONS	ANSWERS
1. What is the deck height at the side shell?	1.
2. What is the deck height at center line?	2.
3. What is the deck height at 17'-6" off center line on knuckle camber?	3.
4. What is the molded breadth of ship?	4.
5. What is the difference between normal camber and knuckle camber?	5.
6. How far is the one-half siding from center line of ship?	6.
7. What is the height of rise of floors?	7.
8. What is the distance between the knuckles on the deck showing knuckle camber?	8.
9. How much camber is shown between the knuckles on the deck?	9.
10. How far is the 17'-6" knuckle from the side shell?	10.



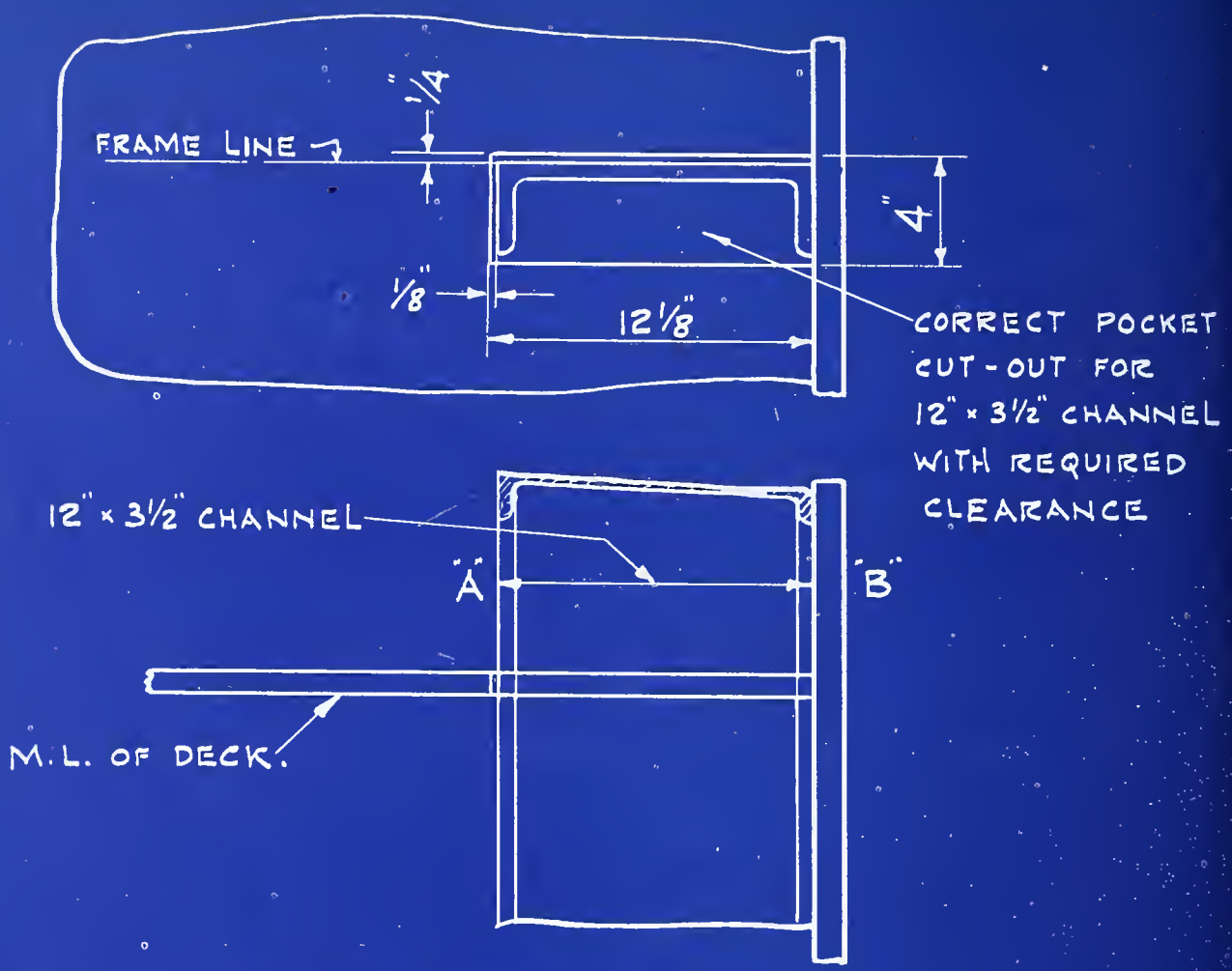
MIDSHIP SECTION, CAMBER

Ship Hull Prints — Assignment Sheet

NAME _____ DATE _____ GRADE _____

Midship Section, Camber
Print No. 6

QUESTIONS	ANSWERS
1. On what decks is camber shown?	1. _____
2. What is the height of the molded line of upper deck, at the center line aft of frame 146?	2. _____
3. What is the height of the molded line upper deck, forward of frame 146?	3. _____
4. What is the height of the following:	
A. Poop deck at the center line of the ship?	4.A. _____
B. Poop deck at the side of the ship?	4.B. _____
C. Forecastle deck at the center line of the ship?	4.C. _____
D. Forecastle deck at the side of the ship?	4.D. _____
5. What is the half-breadths of the knuckles of camber on the following decks:	
A. Upper Deck?	5.A. _____
B. Poop Deck?	5.B. _____
C. Forecastle Deck?	5.C. _____
6. What is the half-breadth of the shell from midship?	6. _____
7. What is the radius of the bilge?	7. _____
8. What is the camber of the poop deck?	8. _____



NO "RAKE" EXPANSION WHEN SHELL IS PERPENDICULAR TO DECK.

FIG. 21

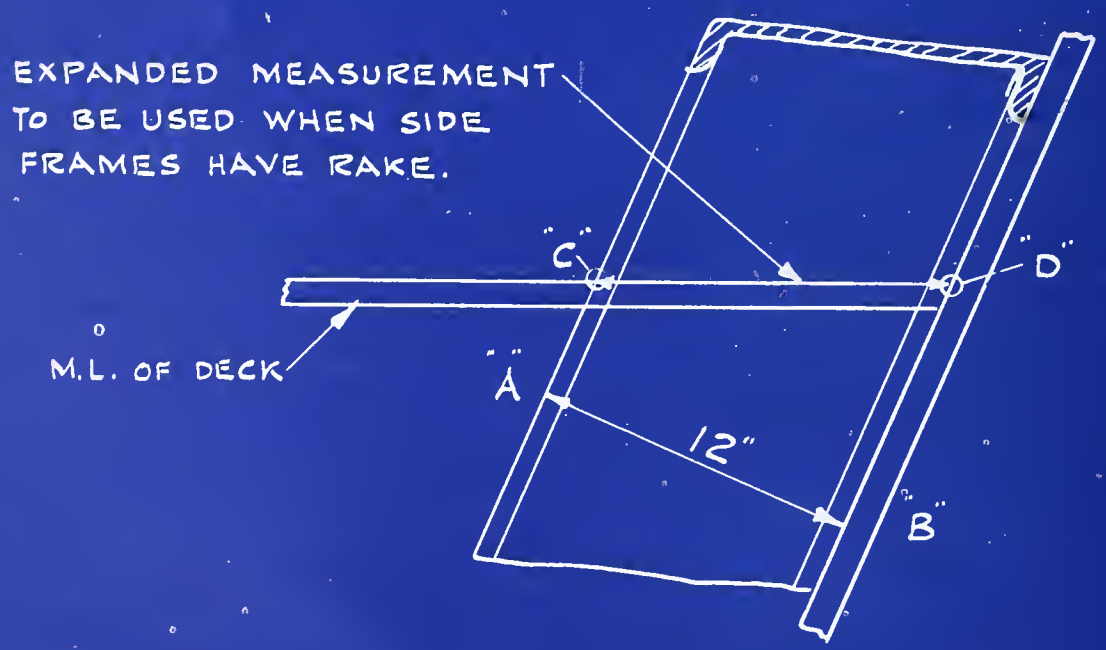


FIG. 22

Ship Hull Prints — Assignment Sheet

NAME — DATE — GRADE

Pocket Cut-Outs
Print No. 7

QUESTIONS	ANSWERS
1. What views are shown on Fig. 21?	1.
2. What views are shown on Fig. 22?	2.
3. What is the clearance from the heel of the channel for a pocket cut-out on a 12" x 3½" channel?	3.
4. What is the clearance from the toe of the channel for a pocket cut-out on a 12" x 3½" channel?	4.
5. What is the clearance from the inboard flange of the channel for a pocket cut-out on a 12" x 3½" channel?	5.
6. Would the expanded measurement "C-D", Fig. 22,be greater or smaller than 12"?	6.
7. Where is the frame line in relation to the channel?	7.
8. What is meant by rake?	8.

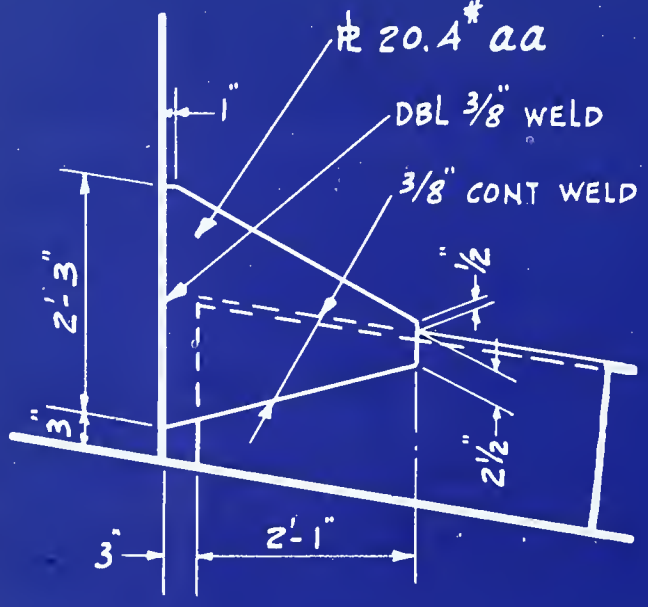


FIG. 23 FLAT PLATE BRKT.

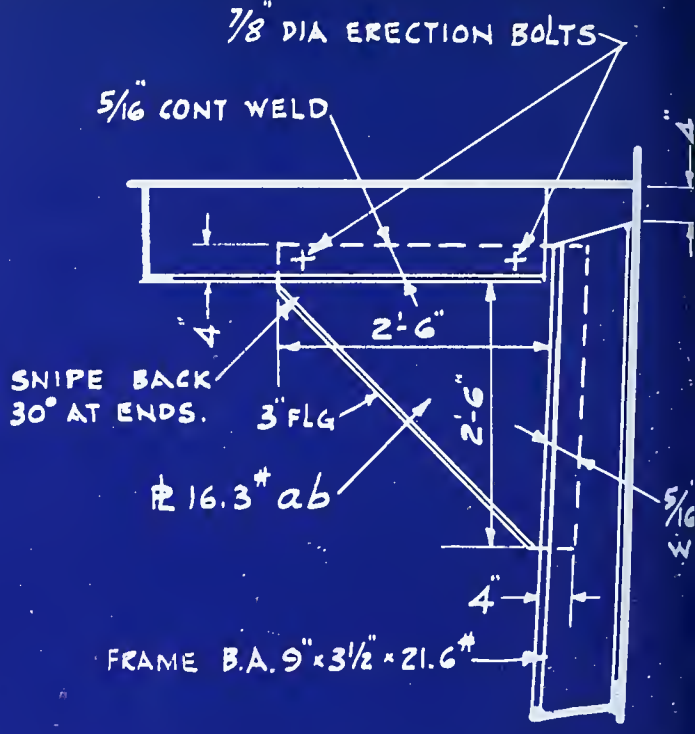
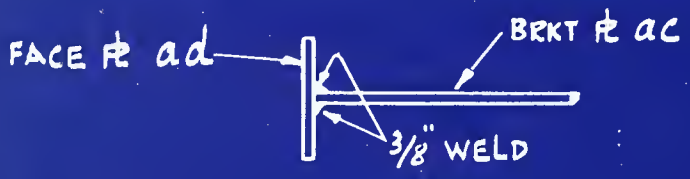
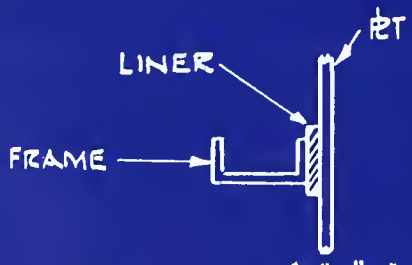


FIG. 24 FLANGED BRKT



SECTION "A"-"A"



SECTION "B"-"B"

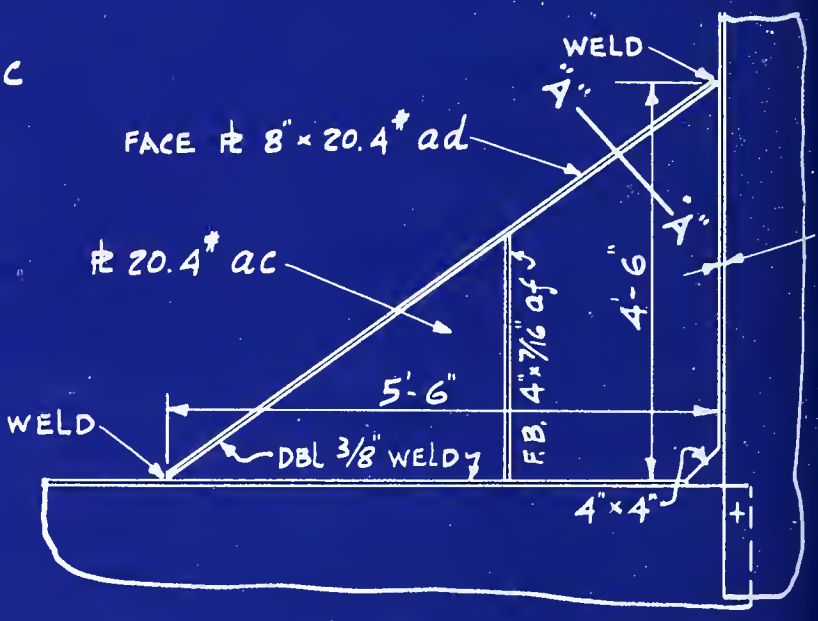


FIG. 25 FACE PLATE BRKT

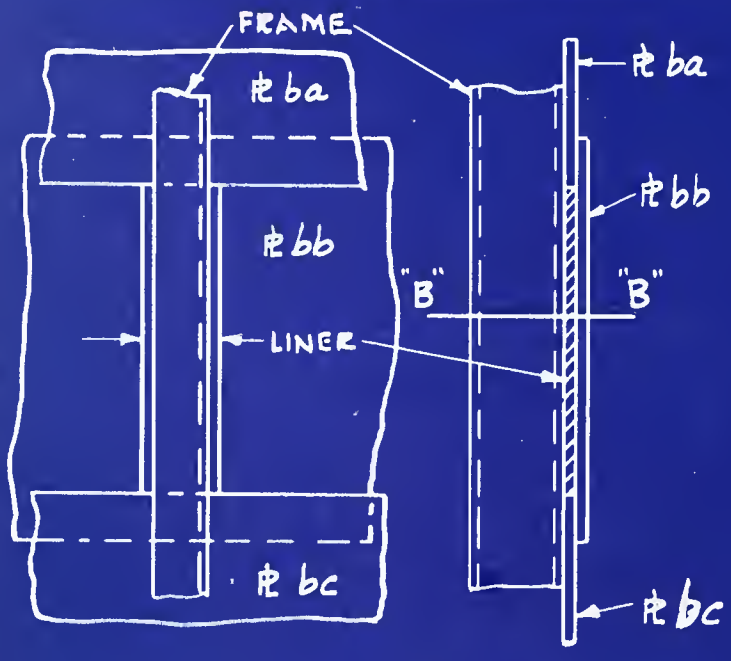


FIG. 26 PARALLEL LINER.

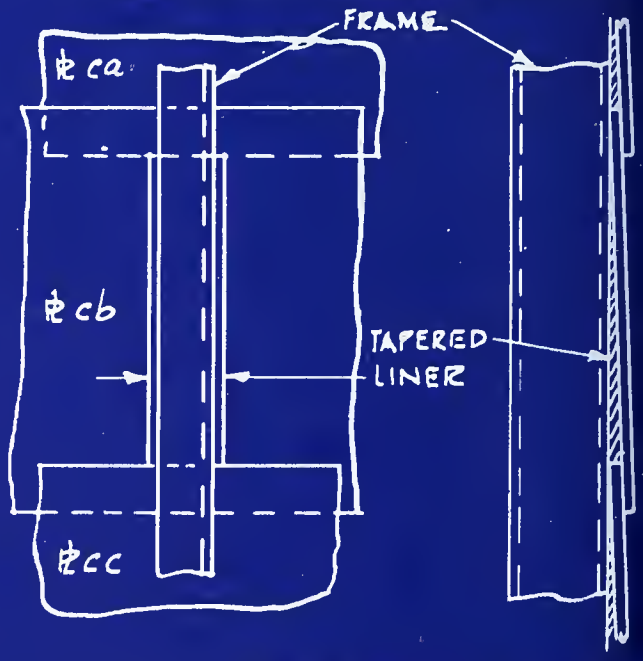


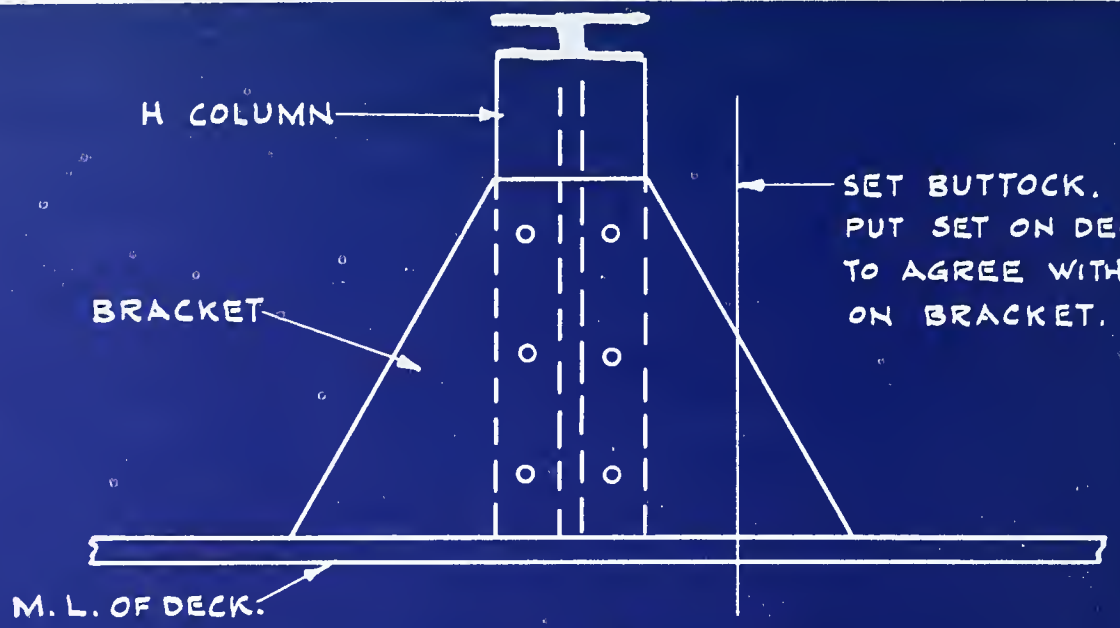
FIG. 27 TAPERED LINER

Ship Hull Prints — Assignment Sheet

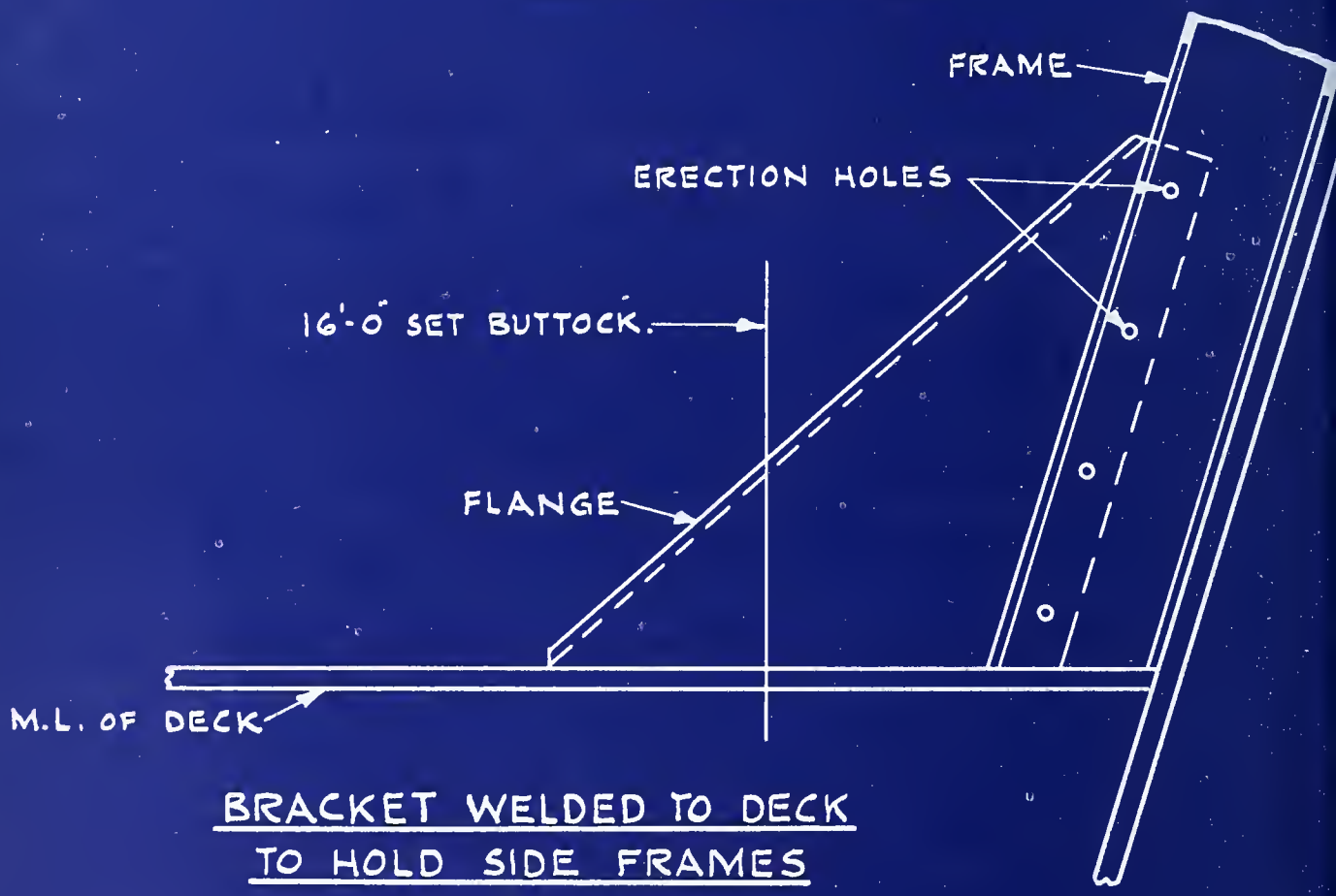
NAME — DATE — GRADE

Brackets and Liners
Print No. 8

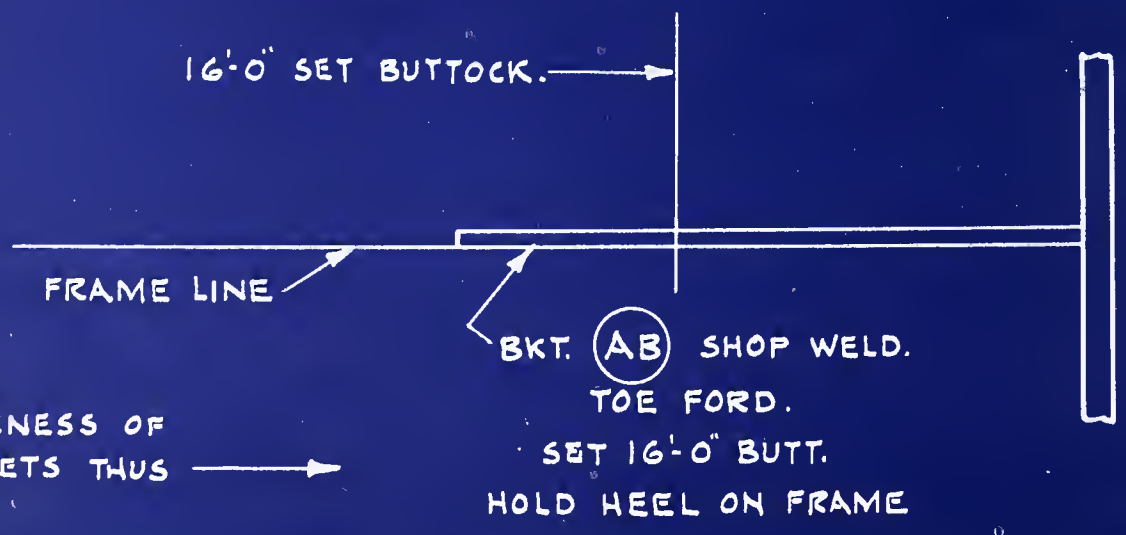
QUESTIONS	ANSWERS
1. What size flange is used on the bracket in Fig. 24?	1.
2. What size cut-out is shown at the corner of the bracket in Fig. 25?	2.
3. What is the width of the face plate shown in Fig. 25?	3.
4. What is the size and identification mark on the flat bar, Fig. 25?	4.
5. Name the three types of brackets shown on Print No. 9.	5.
6. What are the specifications of the bracket in Fig. 23? Include the piece mark, weight, width, and length.	6.
7. At the small end of the bracket, Fig. 23, what size lap is used and how wide is the bracket at this point?	7.
8. Why was section "A-A" drawn?	8.
9. What piece marks are shown on Figs. 26 and 27?	9.
10. Explain the use of a tapered liner.	10.



COLUMN BRACKET.



BRACKET WELDED TO DECK
TO HOLD SIDE FRAMES
TO SET BUTTOCK.



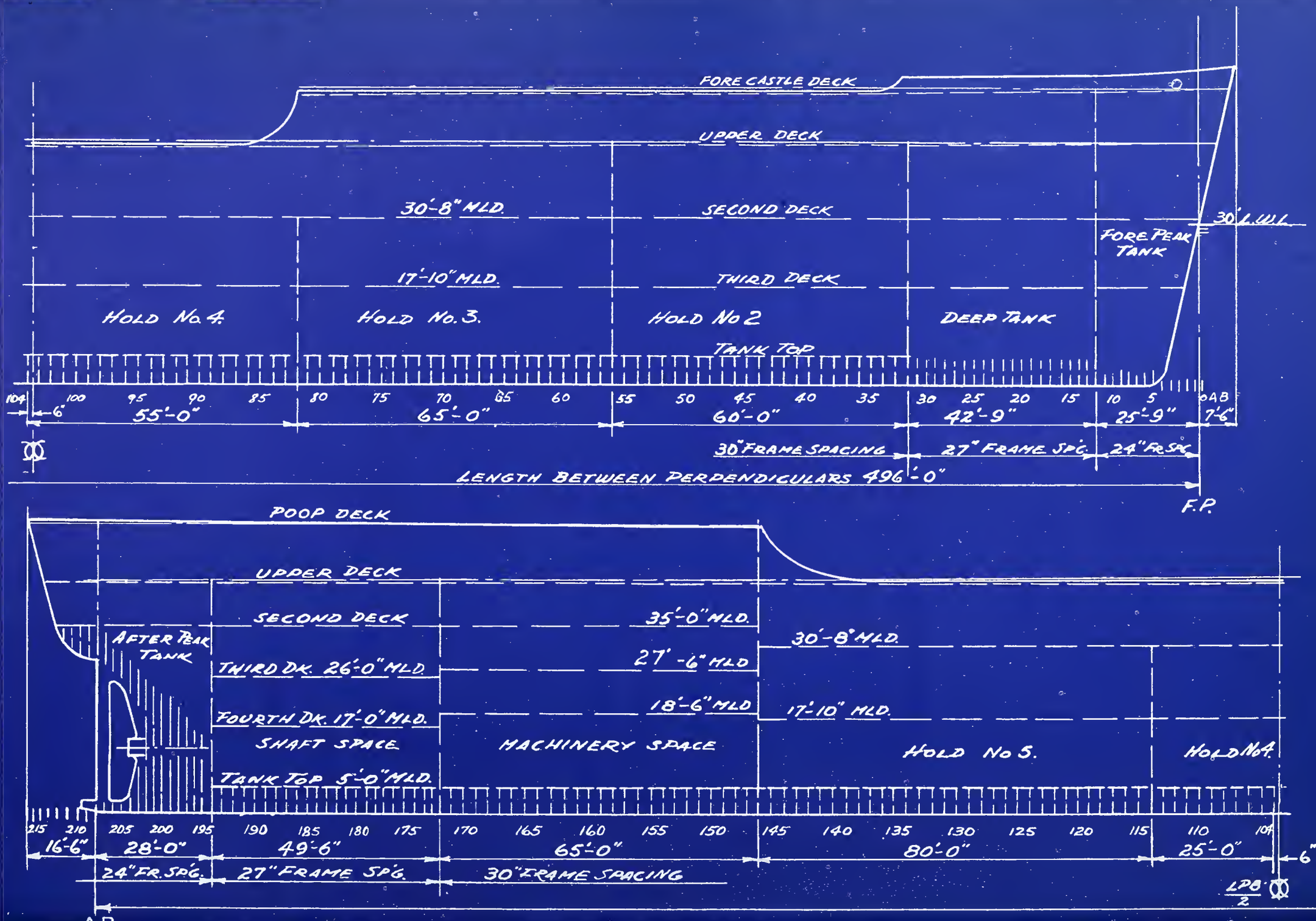
MARK SET
SHOW THICKNESS OF
ALL BRACKETS THUS →

Ship Hull Prints — Assignment Sheet

NAME _____ DATE _____ GRADE _____

Brackets Welded to Deck
Print No. 9

QUESTIONS	ANSWERS
1. What buttock line is used to set the frame brackets to the deck?	_____
2. Where is the molded line of the deck?	_____
3. Where is the heel of the flanged bracket located?	_____
4. How is the heel of the frame bracket held in relation to the frame line?	_____
5. Is the bracket flange toward or away from you?	_____
6. What is the purpose of this bracket?	_____
7. Why are holes shown in the frame and bracket if the bracket is to be welded to the frame?	_____
8. What are the bracket specifications?	_____


FORE CASTLE DECK
UPPER DECK
30'-8" MLD.
SECOND DECK
30' L.W.L.
FORE PEAK TANK
17'-10" MLD.
THIRD DECK
HOLD No. 4.
HOLD No. 3.
HOLD No 2
DEEP TANK
TANK TOP
104 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 AB
6"
55'-0"
65'-0"
60'-0"
42'-9"
25'-9"
7'-6"
30" FRAME SPACING
27" FRAME SPG.
24" FR. SPG.
LENGTH BETWEEN PERPENDICULARS 496'-0"
F.P.
POOP DECK
UPPER DECK
SECOND DECK
35'-0" MLD.
30'-8" MLD.
AFTER PEAK TANK
THIRD DK. 26'-0" MLD.
27'-6" MLD
FOURTH DK. 17'-0" MLD.
18'-6" MLD
17'-10" MLD.
SHAFT SPACE
MACHINERY SPACE
HOLD No 5.
HOLD No 4.
TANK TOP 5'-0" MLD.
215 210 205 200 195 190 185 180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 104
16'-6"
28'-0"
49'-6"
65'-0"
80'-0"
25'-0"
6"
24" FR. SPG.
27" FRAME SPG.
30" FRAME SPACING
LPB/2
AP

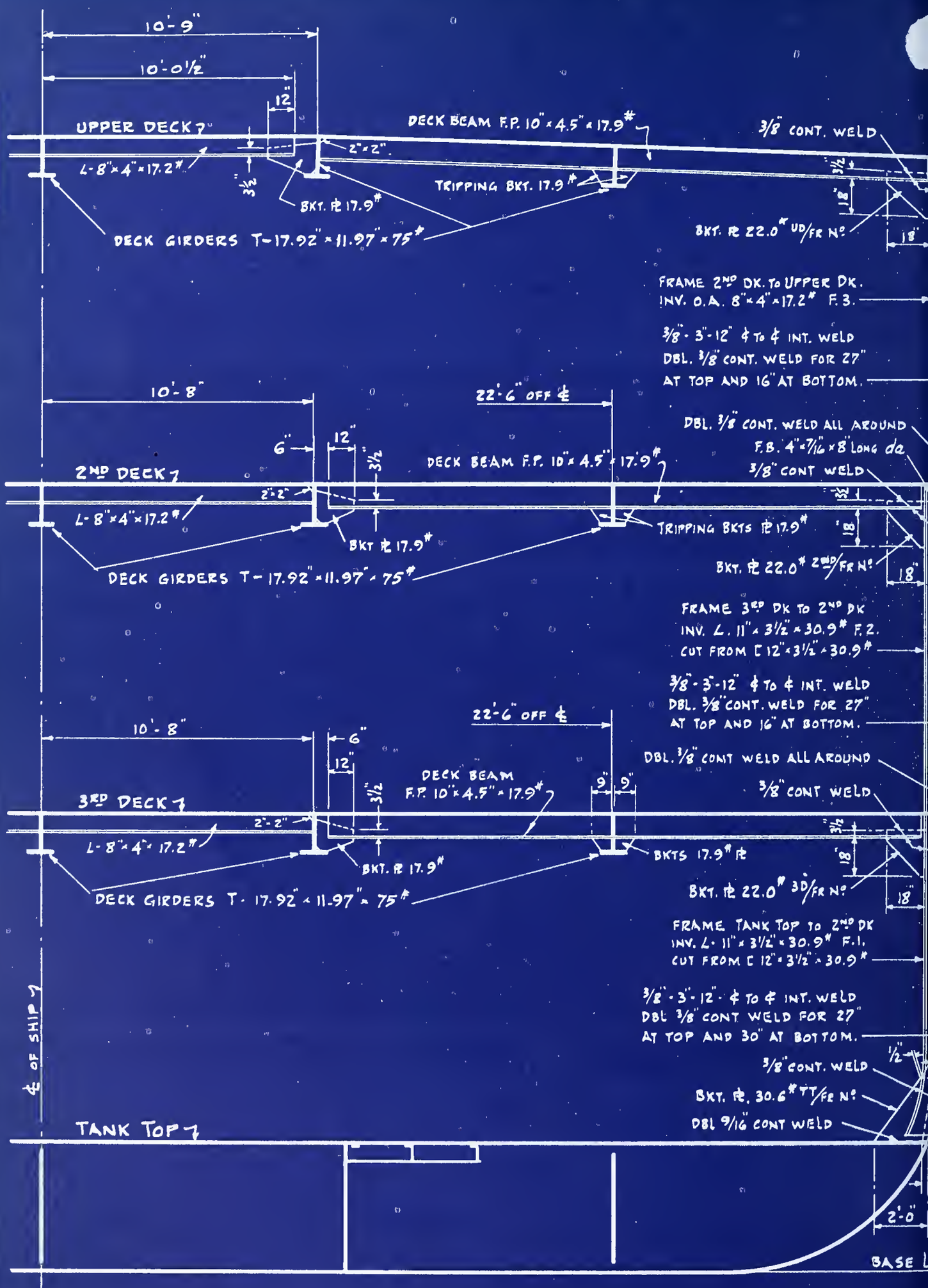
PRINT NO. 10

Ship Hull Prints — Assignment Sheet

NAME — DATE — GRADE

Frame Spacing
Print No. 10

	QUESTIONS	ANSWERS
1.	What is the length between perpendiculars?	1.
2.	What is the frame spacing forward of frame #13?	2.
3.	What is the frame spacing aft of frame #194?	3.
4.	What is the frame spacing in the midship body?	4.
5.	What is the height of the following at frame #180½:	
	A. Tank top? _____ C. Third deck?	_____
	B. Second deck? _____ D. Fourth deck?	_____
6.	How many transverse cargo holds are there on this ship?	6.
7.	What is the name of the uppermost deck at the forward end of the ship?	7.
8.	What is the name of the uppermost deck at the after end?	8.
9.	What is the height of the load water line?	9.
10.	What is the overall length of the ship?	10.
11.	Locate the midship point of this ship.	11.
12.	Is the molded line of the second deck the same from bow to stern?	12.
13.	What is the length of the forecastle deck from the forward perpendicular to frame #82?	13.
14.	What is the overall length of the poop deck?	14.
15.	Locate the following according to frame numbers:	
	A. Shaft space _____ E. Hold 4	_____
	B. Machinery space _____ F. Hold 5	_____
	C. Hold 2 _____ G. Deep tank	_____
	D. Hold 3 _____ H. Forepeak tank	_____



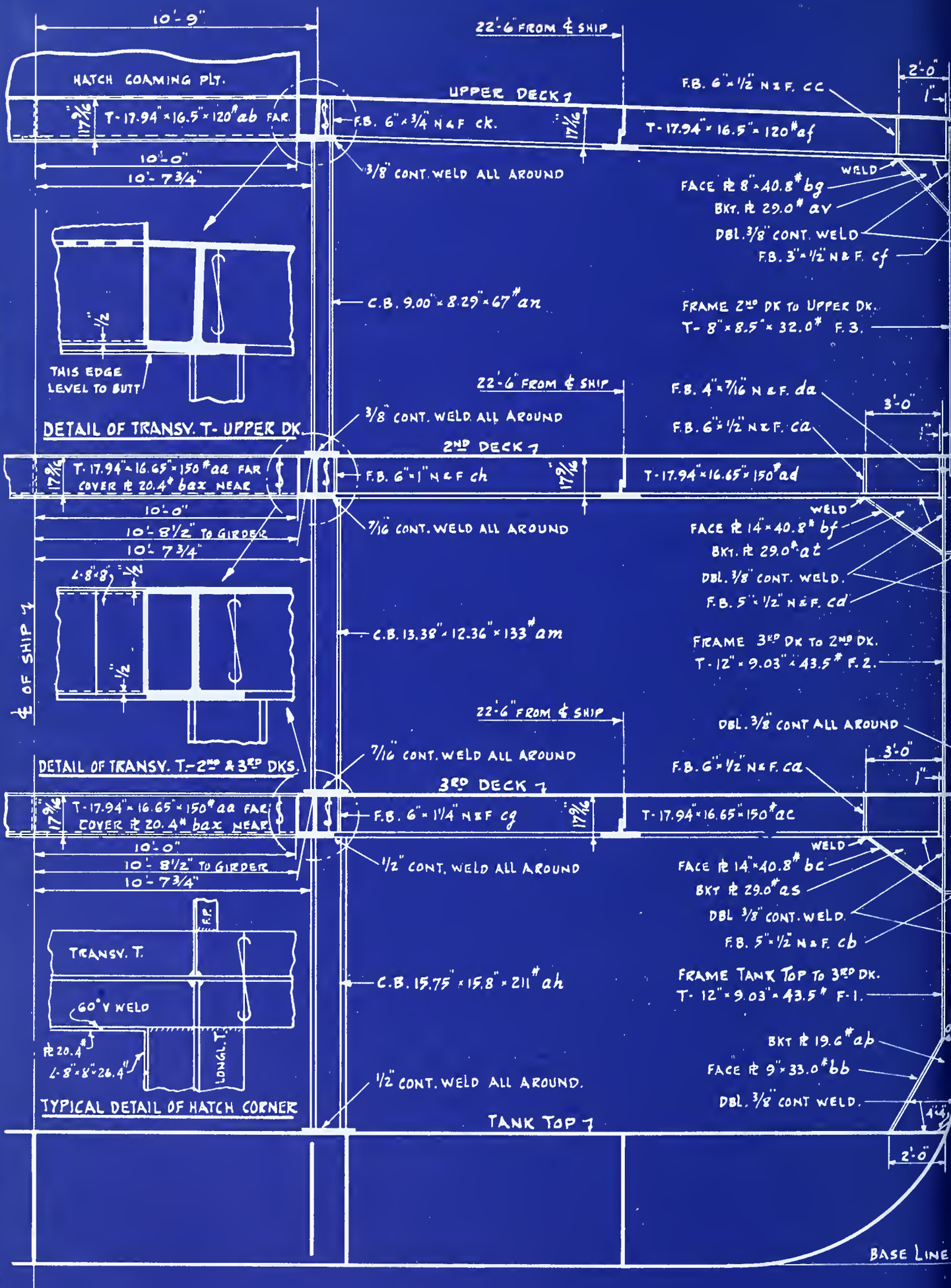
ORDINARY FRAME & BEAMS.

Ship Hull Prints — Assignment Sheet

NAME — DATE — GRADE

Ordinary Frame and Beams
Print No. 11

	QUESTIONS	ANSWERS
1.	What is the size of frame between tank top and third deck?	1.
2.	What is the thickness of plate TT/FR No.?	2.
3.	How much does bracket TT/FR No. overlap the frame at the point 2'-6" above tank top?	3.
4.	What is the size of deck beams at 22'-6" off center line?	4.
5.	What is the size of deck beams at center line?	5.
6.	What is the size of deck girders?	6.
7.	What is the length of bracket plate at girder 10'-8" off center line?	7.
8.	What is the size of bracket plates connecting frame to beam?	8.
9.	What is the size of frame between second deck and upper deck?	9.
10.	What type weld is used to connect bracket UD/FR NO.?	10.



HATCH END FRAME AND BEAMS.

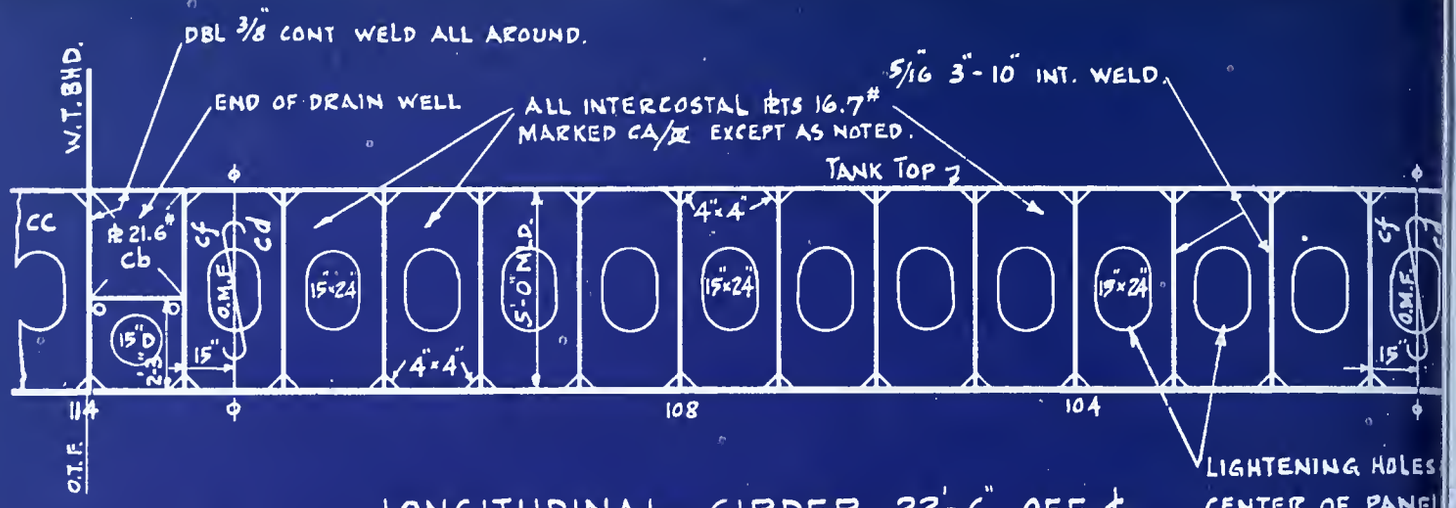
PRINT NO. 12

Ship Hull Prints — Assignment Sheet

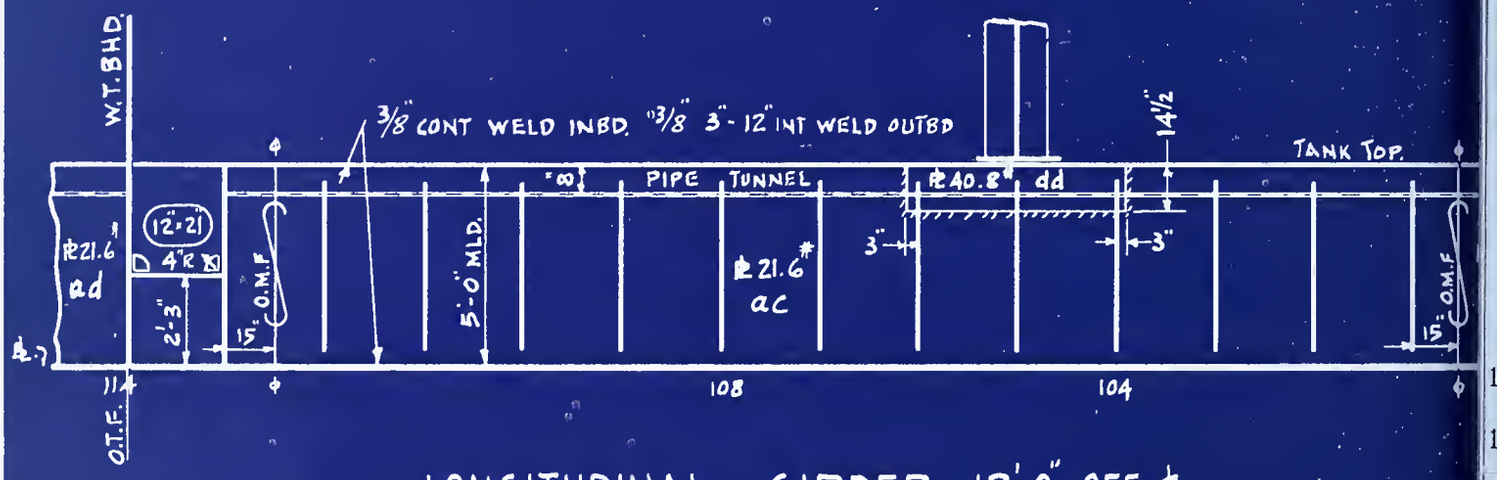
NAME — DATE — GRADE

Hatch End Frame and Beams
Print No. 12

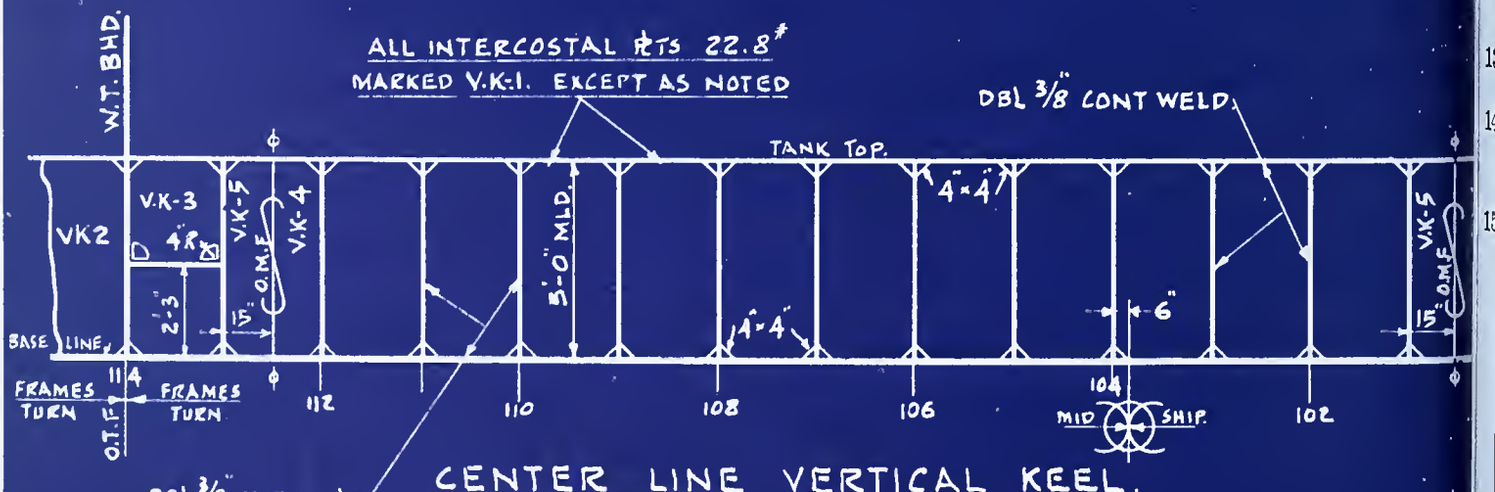
	QUESTIONS	ANSWERS
1.	What is the size of "C.B." column between the tank top and third deck?	1.
2.	What is the size of frame between tank top and third deck?	2.
3.	What is the size of face plate "bb"?	3.
4.	What is the clearance between the deck beam and frame?	4.
5.	The "C.B." column is how far off center line?	5.
6.	What is the size of bracket "as"?	6.
7.	What are the width and thickness of face plate "bf"?	7.
8.	What are the width, thickness, and length of flat bar "da"?	8.
9.	What type welding is used top and bottom of "C.B." column "am"?	9.
10.	How deep is frame "F2"?	10.
11.	What is the size of second deck beam "ad"?	11.
12.	What is the distance from center line to second deck girders.	12.
13.	What is the distance to hatch side from the center line of ship?	13.
14.	How far is it from the upper deck to the end of frame "F3"?	14.
15.	What size bracket connects the upper deck beam to the frame "F3"?	15.
16.	How are the frames connected to the shell?	16.
17.	What is the depth of deck beam "ab" in way of hatch?	17.
18.	What is the depth of deck beam "af" beyond hatch?	18.
19.	How is bracket "at" attached to the frame?	19.
20.	What is the distance from the top of the upper deck at the shell to the top of frame "F3"?	20.



LONGITUDINAL GIRDER 22'-6" OFF ℄
PORT LOOKING OUTBD. STBD. OPPOSITE.
N.T. INTERCOSTAL.



LONGITUDINAL GIRDER 12'-0" OFF ℄.
PORT LOOKING OUTBD. STBD. OPPOSITE.
OIL TIGHT.



CENTER LINE VERTICAL KEEL.
N.T. INTERCOSTAL.

FRAME SPACING 2'-6"

GIRDER PLAN.

FORD →

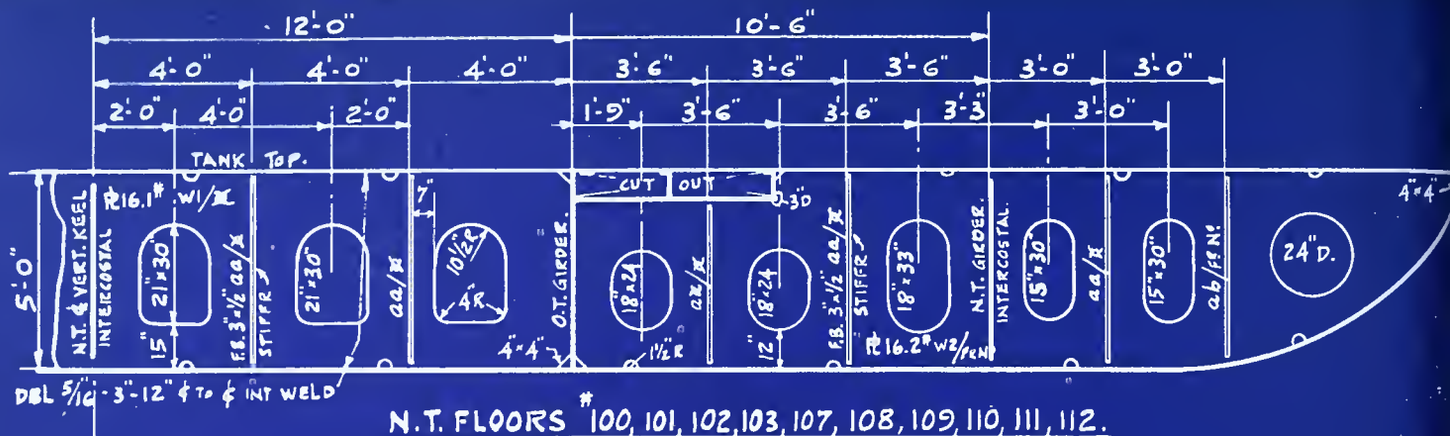
PRINT NO. 13

Ship Hull Prints — Assignment Sheet

NAME — DATE — GRADE

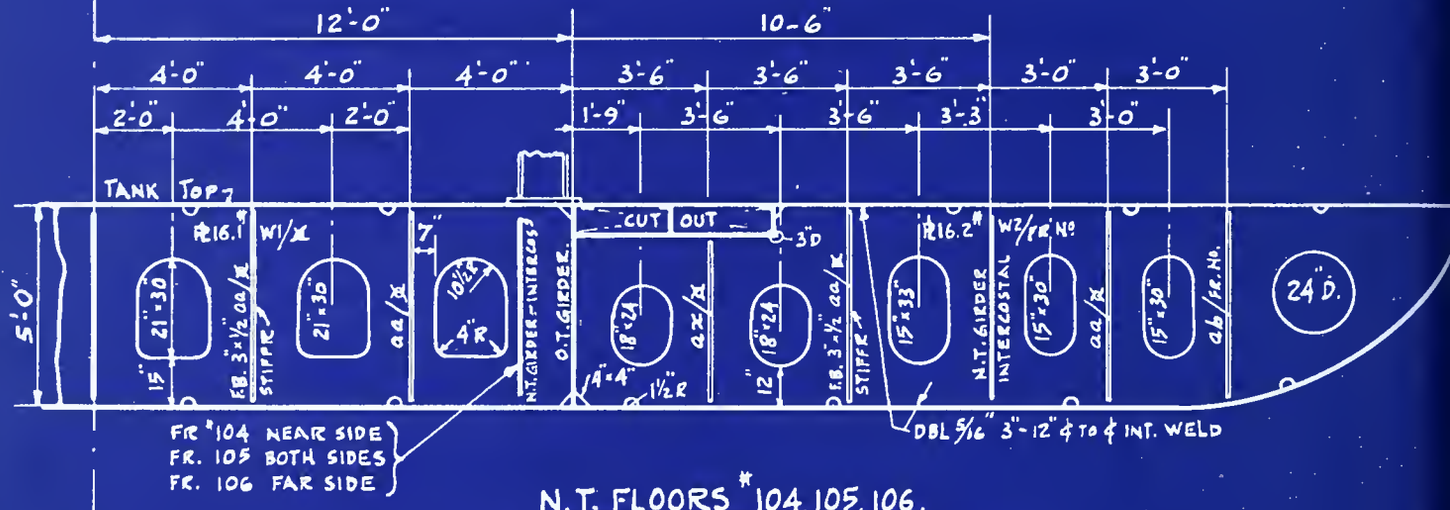
Girder Plan
Print No. 13

QUESTIONS	ANSWERS
Longitudinal Girder 22'-6" Off Center Line	
1. What are the dimensions of the lightening holes in this girder?	1.
2. How high is the tank top above the base line?	2.
3. What type weld is used at the end of the drain well?	3.
4. How high is the drain well above the base line?	4.
5. Locate the watertight bulkhead.	5.
6. What is the weight of the girder plates?	6.
Longitudinal Girder 12'-0" Off Center Line	
7. What is the thickness of plate "ac" on the longitudinal girder?	7.
8. What is the length of the plate "ac"?	8.
9. How deep is the pipe tunnel?	9.
10. What are the dimensions of plate "dd"?	10.
11. Why do the floor lines not touch the tank top or bottom shell?	11.
Center Line Vertical Keel	
12. What is the weight of the plating of the center line vertical keel?	12.
13. What is the size of the corner cut outs?	13.
14. What size plates are used for the center line vertical keel?	14.
15. What type weld is used to connect the floors to the center line vertical keel?	15.



N.T. FLOORS #100, 101, 102, 103, 107, 108, 109, 110, 111, 112.

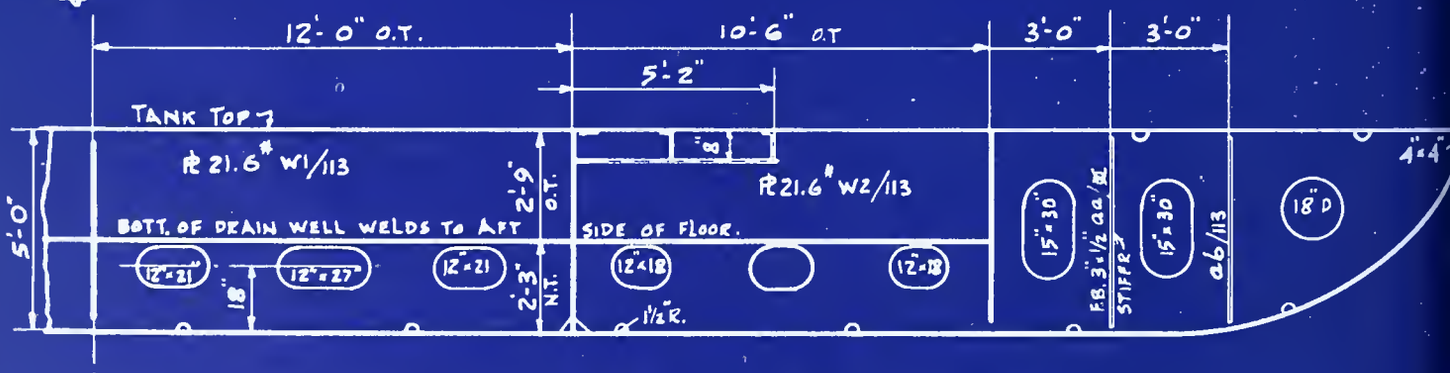
STBD. LOOKING FORD – PORT OPPOSITE.



N.T. FLOORS #104, 105, 106.

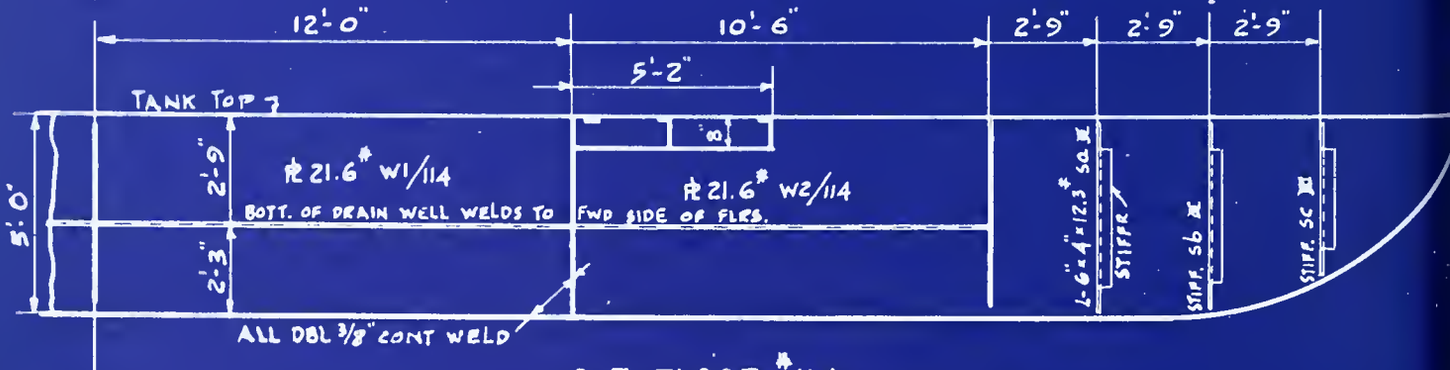
STBD. LOOKING FORD – PORT OPPOSITE.

¢ OF SHIP.



PART O.T. FLOOR #113.

STBD. LOOKING FORD – PORT OPPOSITE.



O.T. FLOOR #114.

STBD. LOOKING FORD – PORT OPPOSITE.

Ship Hull Prints — Assignment Sheet

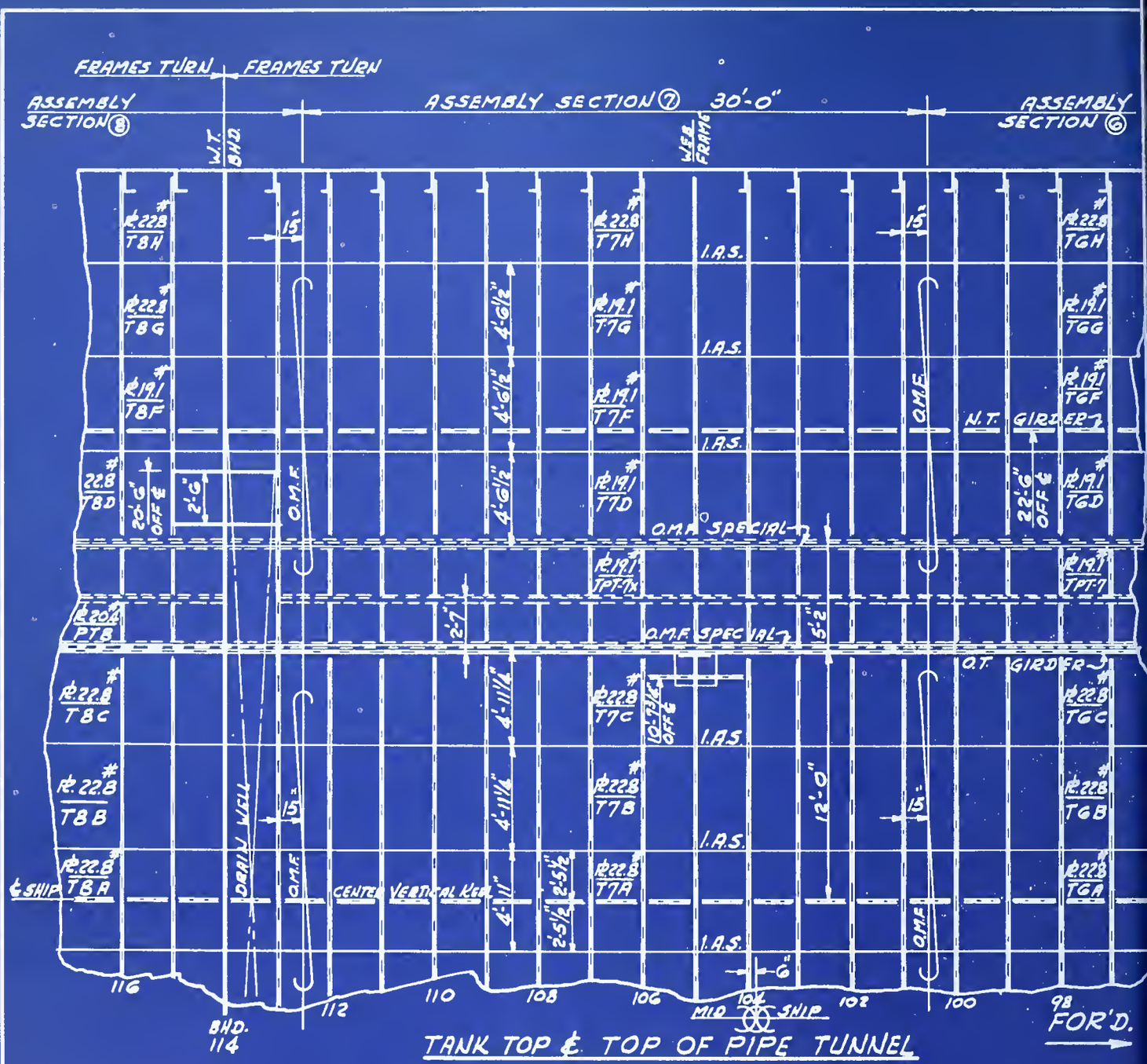
NAME — DATE — GRADE

Floor Plan
Print No. 14

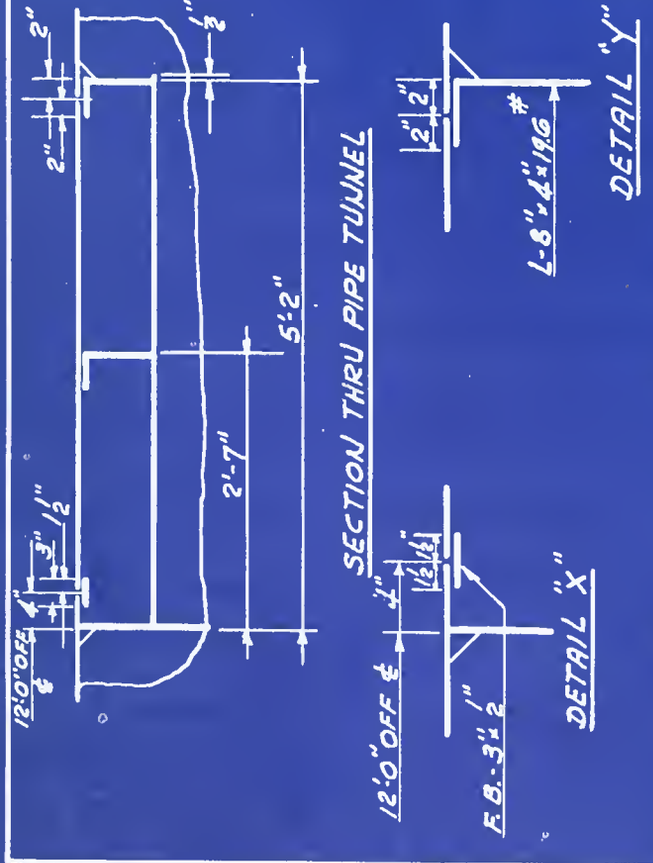
QUESTIONS	ANSWERS
1. What size are the stiffeners on this floor?	1.
2. What is the spacing between the stiffeners on the oil tight floor #114?	2.
3. What is the size of the cut out for the pipe tunnel?	3.
4. What is the depth of the drain well from the tank top?	4.
5. What is the height of floor #113?	5.
6. What size lightening holes are used outboard of the 22'-6" girder on floors #104, 105, and 106?	6.

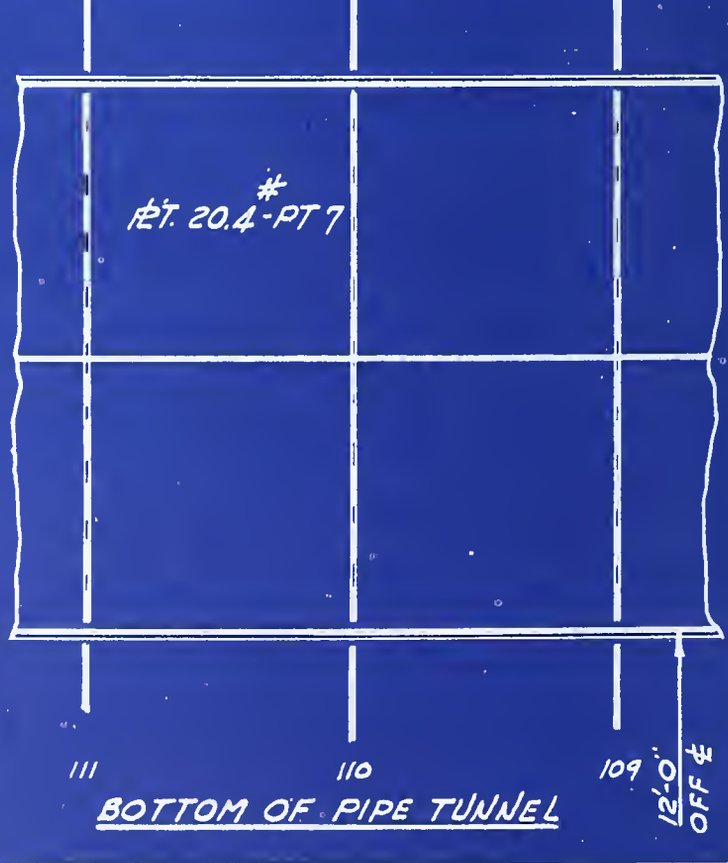
Answer the following questions by referring to the print of floors #100 to #112.

7. What is the distance from the center line to the oil tight girder?	7.
8. What is the spacing between the stiffeners from the center line of ship to the 12'-0" girder?	8.
9. What is the size of the cut out where the tank top and shell meet?	9.
10. Locate the lightening hole nearest to the center line of ship.	10.
11. What is the meaning of the "3" D." at the corner of the pipe tunnel cut out?	11.
12. What size and type weld is used to weld the floor to the tank top?	12.
13. What is the distance from the center line of ship to the last stiffener outboard?	13.
14. What is the distance between the center lines of the two lightening holes nearest the vertical keel?	14.
15. What is the distance from the oil tight girder to the center line of the first lightening hole outboard?	15.



TANK TOP & TOP OF PIPE TUNNEL





BOTTOM OF PIPE TUNNEL

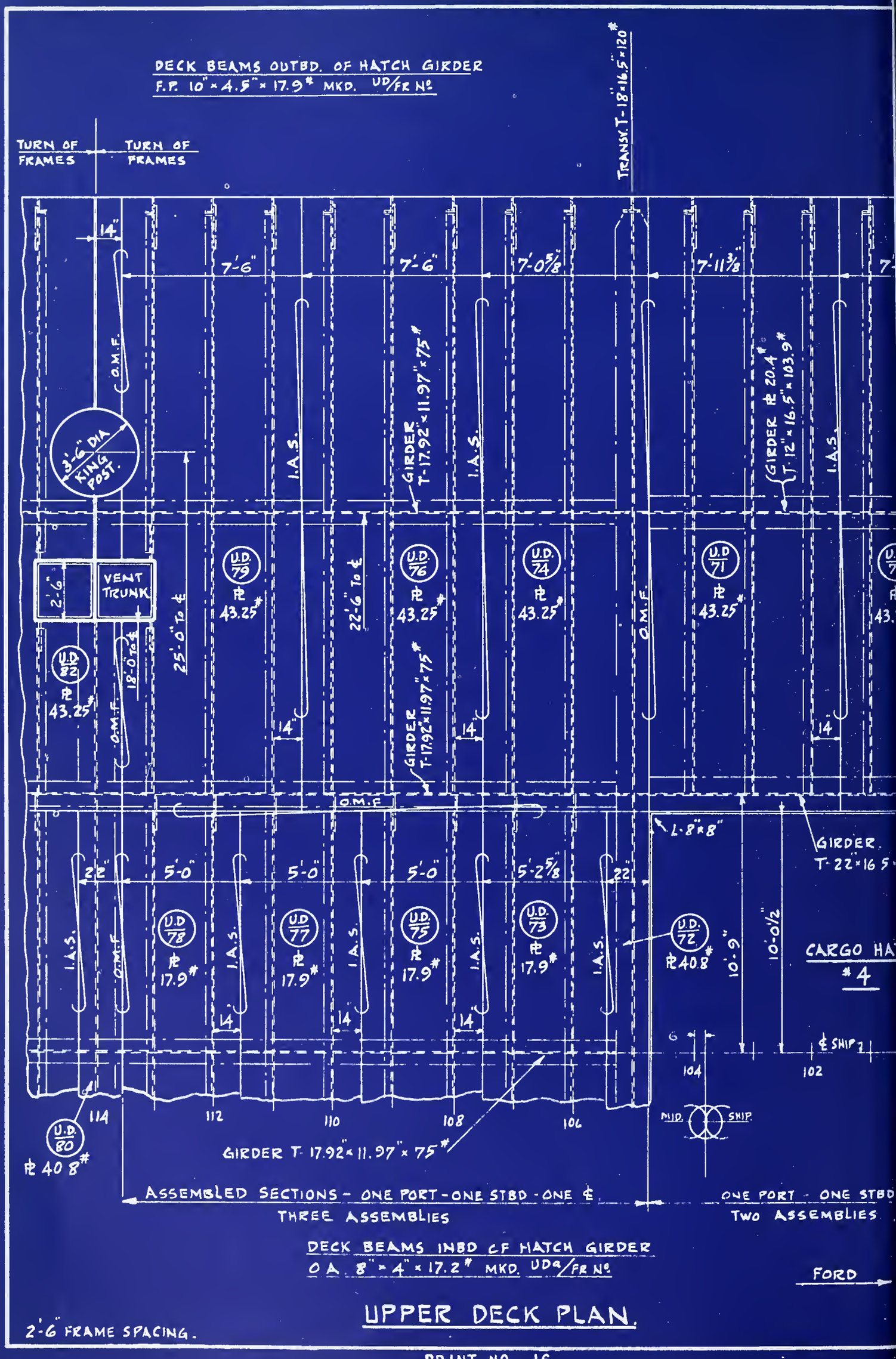
PRINT NO. 15

Ship Hull Prints — Assignment Sheet

NAME — DATE — GRADE

Tank Top Plan and Pipe Tunnel
Print No. 15

QUESTIONS	ANSWERS
1. What is the length of the assembly section 7?	1.
2. On what frame is the watertight bulkhead located?	2.
3. What is the frame number of the web frame?	3.
4. Which frames toe forward and which toe aft?	4.
5. Locate the assembly section 7 in reference to the frame line.	5.
6. What is the weight of plating that connects to the shell?	6.
7. What is the width of plating that connects to the girder 22'-6" off center line of ship?	7.
8. What is the weight of the plate on the top of the pipe tunnel?	8.
9. How far off center line is the inboard side of the pipe tunnel?	9.
10. What is the width and depth of the pipe tunnel?	10.
11. How far does the tank top plate overlap the tunnel angle?	11.
12. How far does the tank top plating extend past the 12'-0" girder?	12.


DECK BEAMS OUTBD. OF HATCH GIRDER
F.P. 10" × 4.5" × 17.9# MKD. UD/FR Nº
TURN OF FRAMES
TURN OF FRAMES
TRANSV. T-18"×16.5"×120#
14"
7'-6"
7'-6"
7'-0 5/8"
7'-11 3/8"
O.M.F.
3'-6" DIA KING POST.
I.A.S.
GIRDER T-17.92"×11.97"×75#
GIRDER ℔ 20.4# T-12"×16.5"×103.9#
2'-6"
VENT TRUNK
U.D. 79 ℔ 43.25#
U.D. 76 ℔ 43.25#
U.D. 74 ℔ 43.25#
U.D. 71 ℔ 43.25#
U.D. 82 ℔ 43.25#
25'-0" To ℄
22'-6" To ℄
18'-0" To ℄
GIRDER T-17.92"×11.97"×75#
L-8"×8"
GIRDER T-22"×16 5
22"
5'-0"
5'-0"
5'-0"
5'-2 5/8"
22"
U.D. 78 ℔ 17.9#
U.D. 77 ℔ 17.9#
U.D. 75 ℔ 17.9#
U.D. 73 ℔ 17.9#
U.D. 72 ℔ 40.8#
10'-9"
10'-0 1/2"
CARGO HA
#4
℄ SHIP
104
102
MID. SHIP
114
112
110
108
106
U.D. 80 ℔ 40 8#
GIRDER T-17.92"×11.97"×75#
ASSEMBLED SECTIONS - ONE PORT - ONE STBD - ONE ℄
THREE ASSEMBLIES
ONE PORT - ONE STBD
TWO ASSEMBLIES
DECK BEAMS INBD OF HATCH GIRDER
O A. 8" × 4" × 17.2# MKD. UDa/FR Nº
FORD
UPPER DECK PLAN.
2'-6" FRAME SPACING.

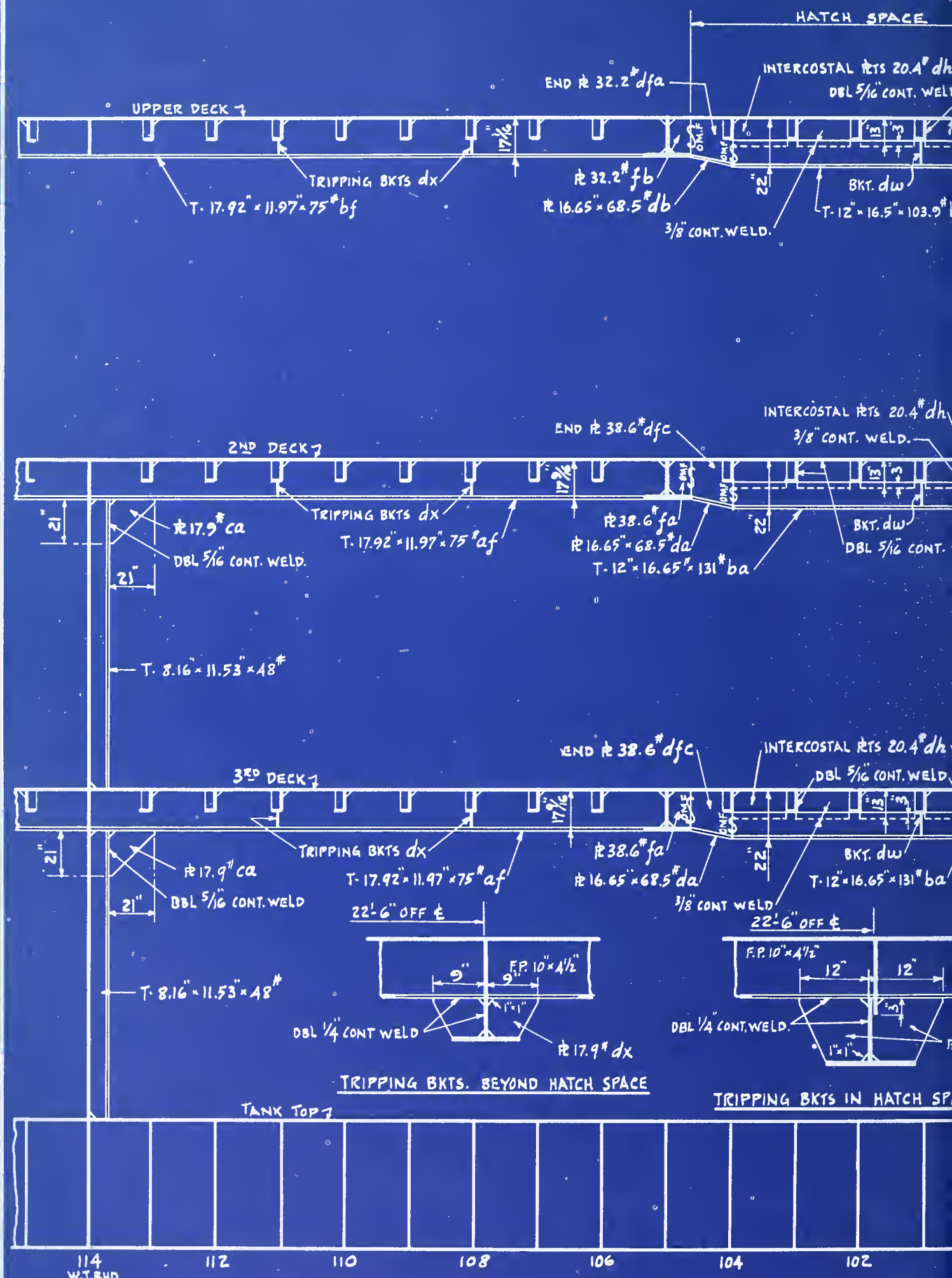
PRINT NO. 16

Ship Hull Prints — Assignment Sheet

NAME — DATE — GRADE

Upper Deck Plan
Print No. 16

	QUESTIONS	ANSWERS
1.	What is the length of the deck beam between the hatch side girders?	1.
2.	What is the thickness in inches of the deck plating outboard of the hatch girder?	2.
3.	What is the depth of the girder at the center line of ship?	3.
4.	How far off the center line of ship is the hatch side girder?	4.
5.	What is the total length of the assembly section?	5.
6.	Locate the butt plates UD/76 and UD/74.	6.
7.	What is the distance between the hatch side girder and the girder 22'-6" off center line?	7.
8.	Locate the vent trunk in reference to the center line of the ship.	8.
9.	What structural shape is used for the deck beams inboard of the hatch girder?	9.
10.	In which direction do the deck beams toe forward of frame #114?	10.
11.	Locate the king post on the deck.	11.
12.	Locate the butt between plates UD/70 and UD/71.	12.
13.	Explain the abbreviation "O.M.F." on the butt between plates UD/71 and UD/74.	13.
14.	Locate the midship point in relation to the nearest frame.	14.
15.	What is the depth of the hatch side girder?	15.



LONG'L GIRDERS 22'-6" OFF ℄ OFF SHIP.

PORT SHOWN LOOKING OUTBD – STBD OPPOSITE.

FRAME SPACING 2'-6"

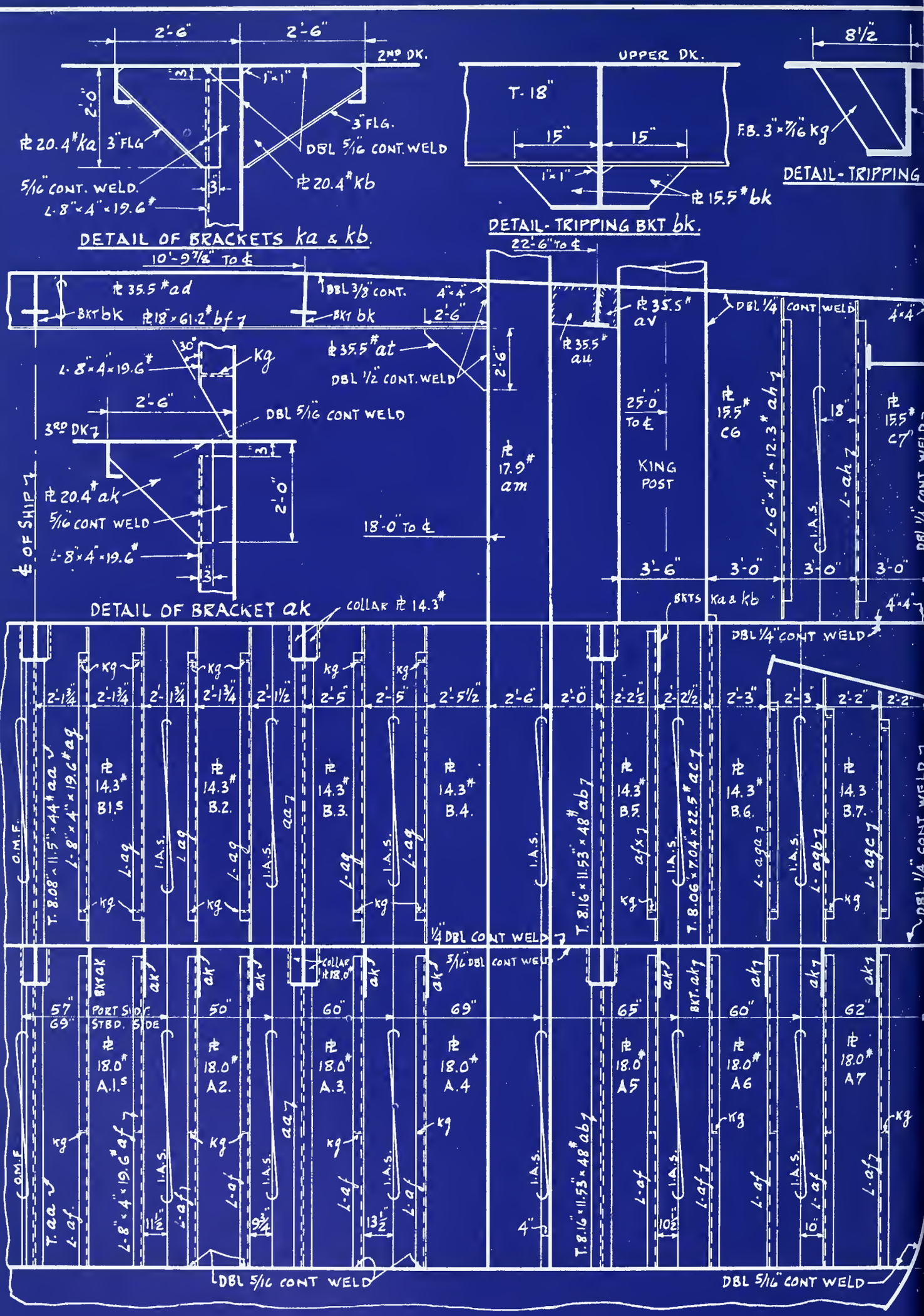
PRINT NO. 17

Ship Hull Prints — Assignment Sheet

NAME — DATE — GRADE

Longitudinal Deck Girders
Print No. 17

QUESTIONS	ANSWERS
Upper Deck	
1. What is the size of upper deck girder aft of frame #105?	1.
2. How deep is the girder?	2.
3. How thick are the intercostal plates "dh"?	3.
4. Of what does the girder in the hatch space consist?	4.
5. What is the weight of plate "fb"?	5.
Second Deck	
6. What is the size of bracket plate "ca"?	6.
7. How deep is the girder aft of frame #105?	7.
8. How deep is the girder forward of frame #105?	8.
9. What size lap is used to connect plate "dh" to T-bar "ba" in hatch space?	9.
10. What type weld is used at the lap?	10.
Third Deck	
11. On which frames are brackets "dx" located?	11.
12. Do the deck beams stop at the girder?	12.
13. What type welding connects brackets "dx" and "dw" to beam and girder?	13.
14. What is the length of brackets "dx" at the deck beam?	14.
15. What size cut outs are used on brackets "dw"?	15.



TRANSVERSE BHD. Nº 114.

STBD LOOKING FORD - PORT SIDE OPPOSITE

Ship Hull Prints — Assignment Sheet

NAME _____ DATE _____ GRADE _____

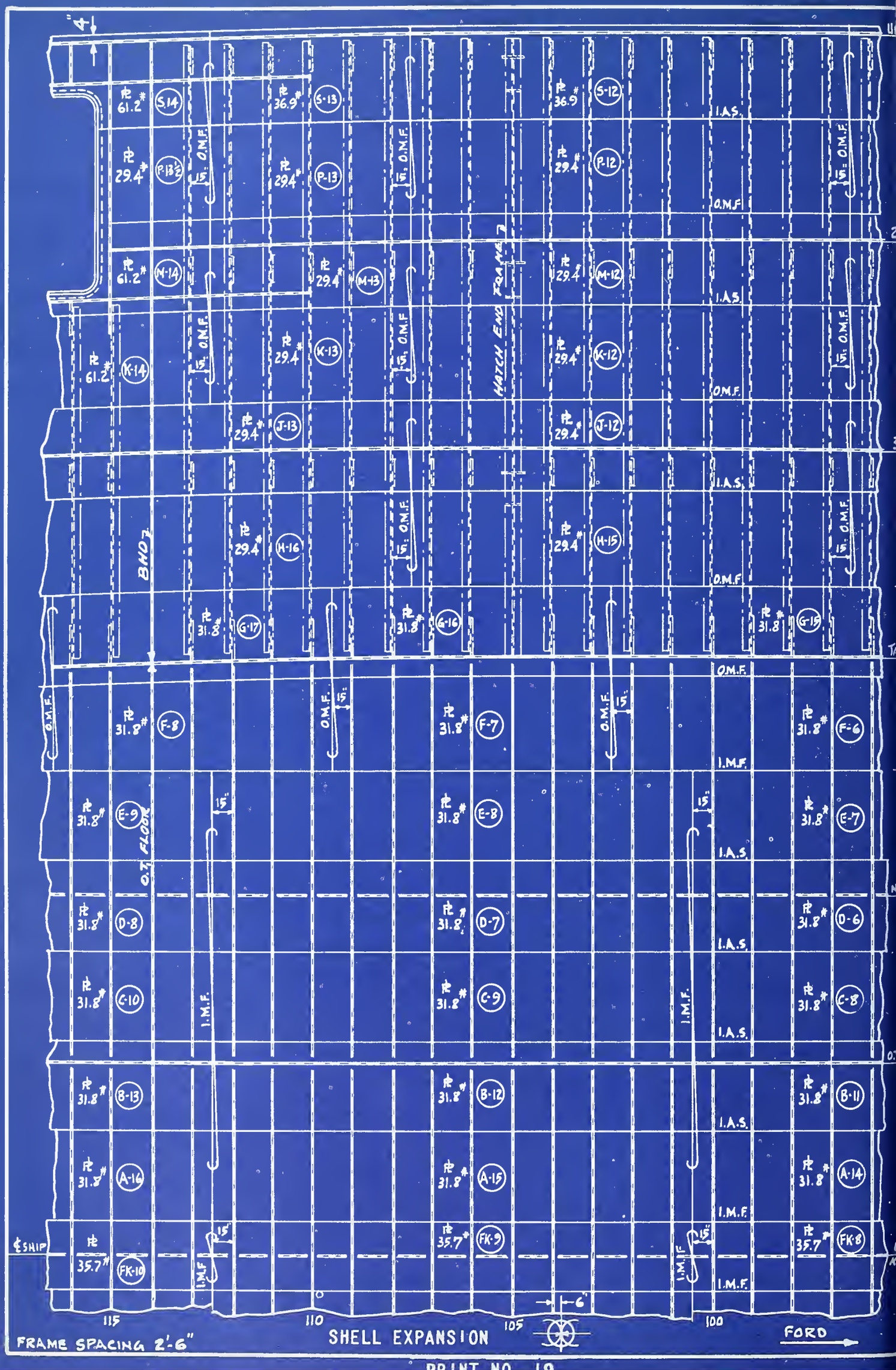
Transverse Bulkhead No. 114

Print No. 18

	QUESTIONS	ANSWERS
1.	How many plates are there between the second deck from port to starboard?	1. _____
2.	What is the size of bracket "ak"?	2. _____
3.	How many type "ak" brackets are used on bulkhead #114?	3. _____
4.	What is the difference between stiffeners "af" and "ag"?	4. _____
5.	How many collar plates are there on the entire bulkhead?	5. _____
6.	What is meant by "starboard looking forward - port side opposite"?	6. _____
7.	What is the width of bulkhead #114?	7. _____
8.	How many type "bk" brackets are used on bulkhead #114?	8. _____
9.	What type weld is used on the third deck?	9. _____
10.	Where are brackets "kg" used?	10. _____
11.	How many "T" bar stiffeners are used on this bulkhead?	11. _____
12.	Locate the butt of plate "C7" and explain the type weld used on this butt.	12. _____
13.	When are brackets "ka" and "kb" used?	13. _____
14.	What is the difference between brackets "ka" and "ak"?	14. _____
15.	What are the widths of the following plates?	

A. B-6 _____ C. B-3 _____

B. B-4 _____ D. B-1^{p} _____


#4
S-14
S-13
S-12
P-13½
P-13
P-12
M-14
M-13
M-12
K-14
K-13
K-12
J-13
J-12
H-16
H-15
G-17
G-16
G-15
F-8
F-7
F-6
E-9
E-8
E-7
D-8
D-7
D-6
C-10
C-9
C-8
B-13
B-12
B-11
A-16
A-15
A-14
FK-10
FK-9
FK-8
O.M.F.
I.M.F.
I.A.S.
15"
HATCH END FRAME 2
BHD 2
O.T. FLOOR
115
110
105
100
6'
FRAME SPACING 2'-6"
SHELL EXPANSION
FORD

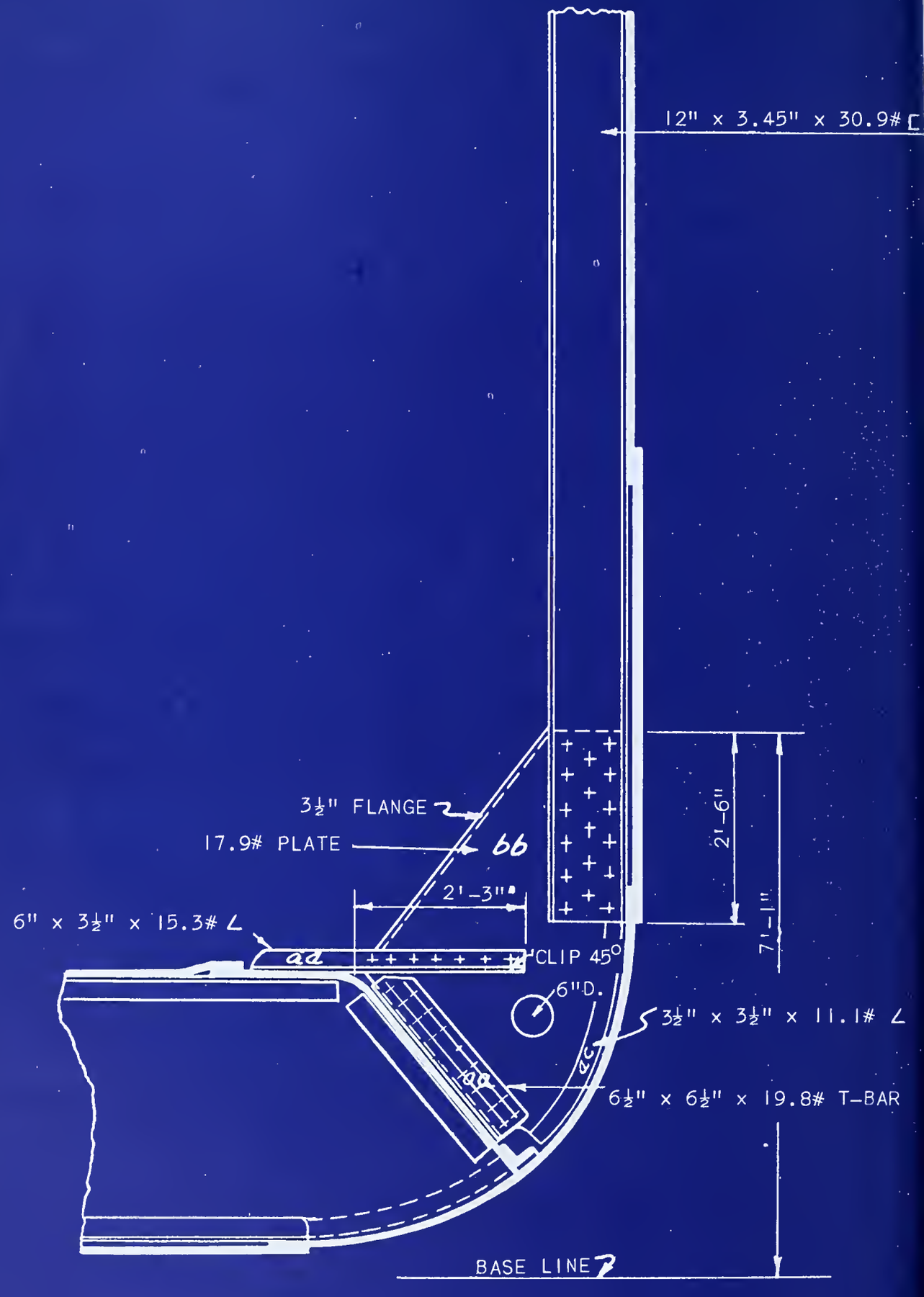
PRINT NO. 19

Ship Hull Prints — Assignment Sheet

NAME — DATE — GRADE

Shell Expansion
Print No. 19

	QUESTIONS	ANSWERS
1.	Are you looking at this shell plan from the inside or outside of the ship? Explain how you determine the answer.	1.
2.	To what strake of plates is the second deck attached?	2.
3.	The bilge section includes what two strakes of plates?	3.
4.	Locate the "I.M.F." butts of the flat keel plates.	4.
5.	Compare the thickness of the "B" strake of plates with the thickness of the "J" strake of plates.	5. (B) (J)
6.	What strakes of plates are included in the side shell?	6.
7.	Are the side shell plates riveted or welded?	7.
8.	What strakes of plates are included in the bottom shell?	8.
9.	How far above the upper deck does the shell plating extend?	9.
10.	On what strake of plates is the oil tight girder located?	10.
11.	What kind of structural shape is used for the frames?	11.
12.	Are the side shell, bilge, and bottom shell plating arranged so that a continuous seam will extend from the upper deck to the keel? Why?	12.



BILGE SECTION AT FRAME 85

Riveted Construction

Cargo

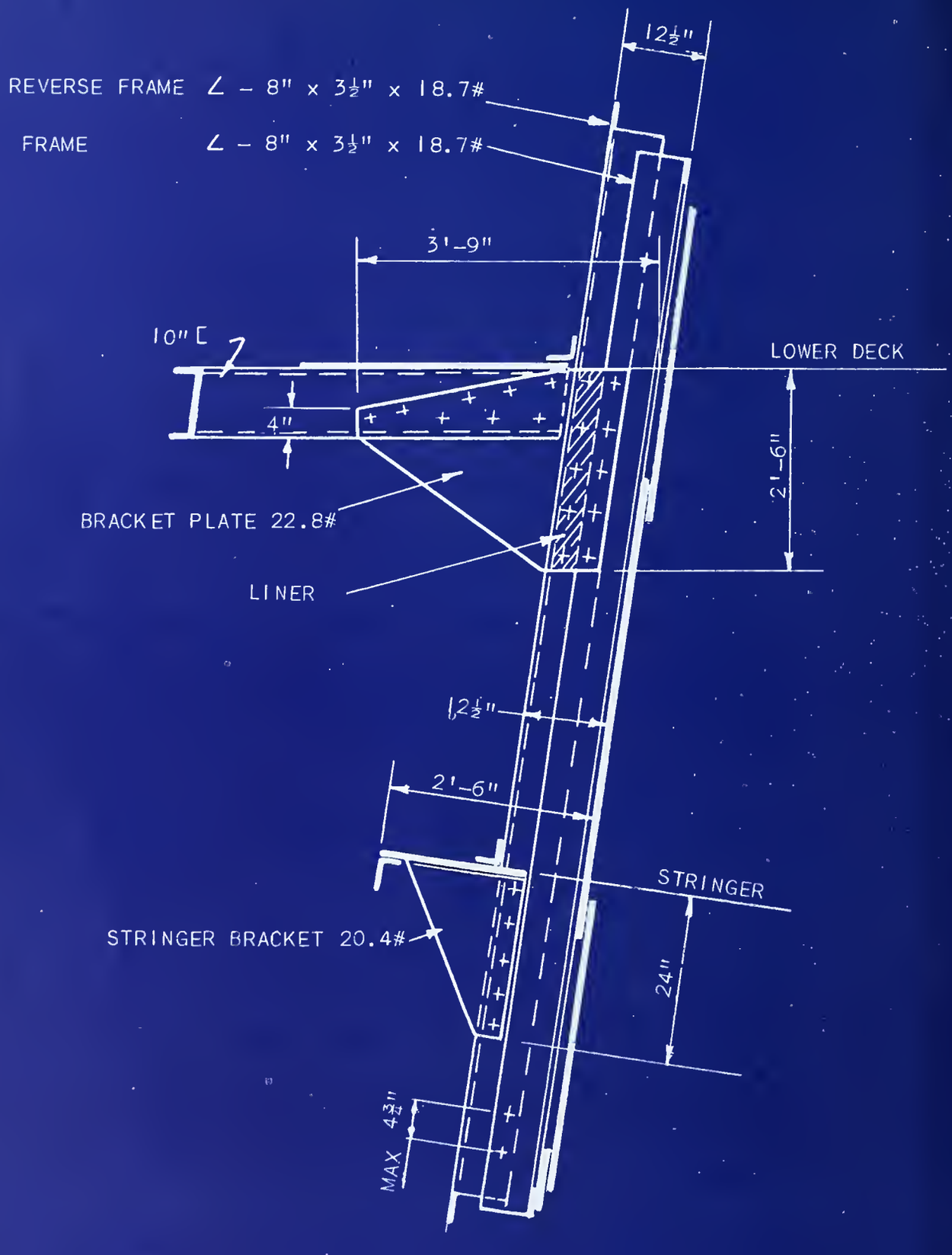
PRINT NO. 20

Ship Hull Prints — Assignment Sheet

NAME — DATE — GRADE

Bilge Section
Riveted Construction
Print No. 20

QUESTIONS	ANSWERS
1. What is the size of frame bar?	1.
2. How many rivets connect the frame to the bracket "bb"?	2.
3. What is the size of the member connecting tank margin plate to bilge bracket "bb"?	3.
4. What is the weight of bilge bracket and size of flange?	4.
5. What is the height of bracket above base line?	5.
6. What is the size of the lightening hole?	6.
7. The frame is made of what structural shape?	7.
8. Does the flange on the bracket toe toward you or away from you?	8.
9. What is the structural shape along the inside of shell at the bilge?	9.
10. Do the flanges on the frame toe toward you or away from you?	10.



SIDE FRAME

Riveted Construction

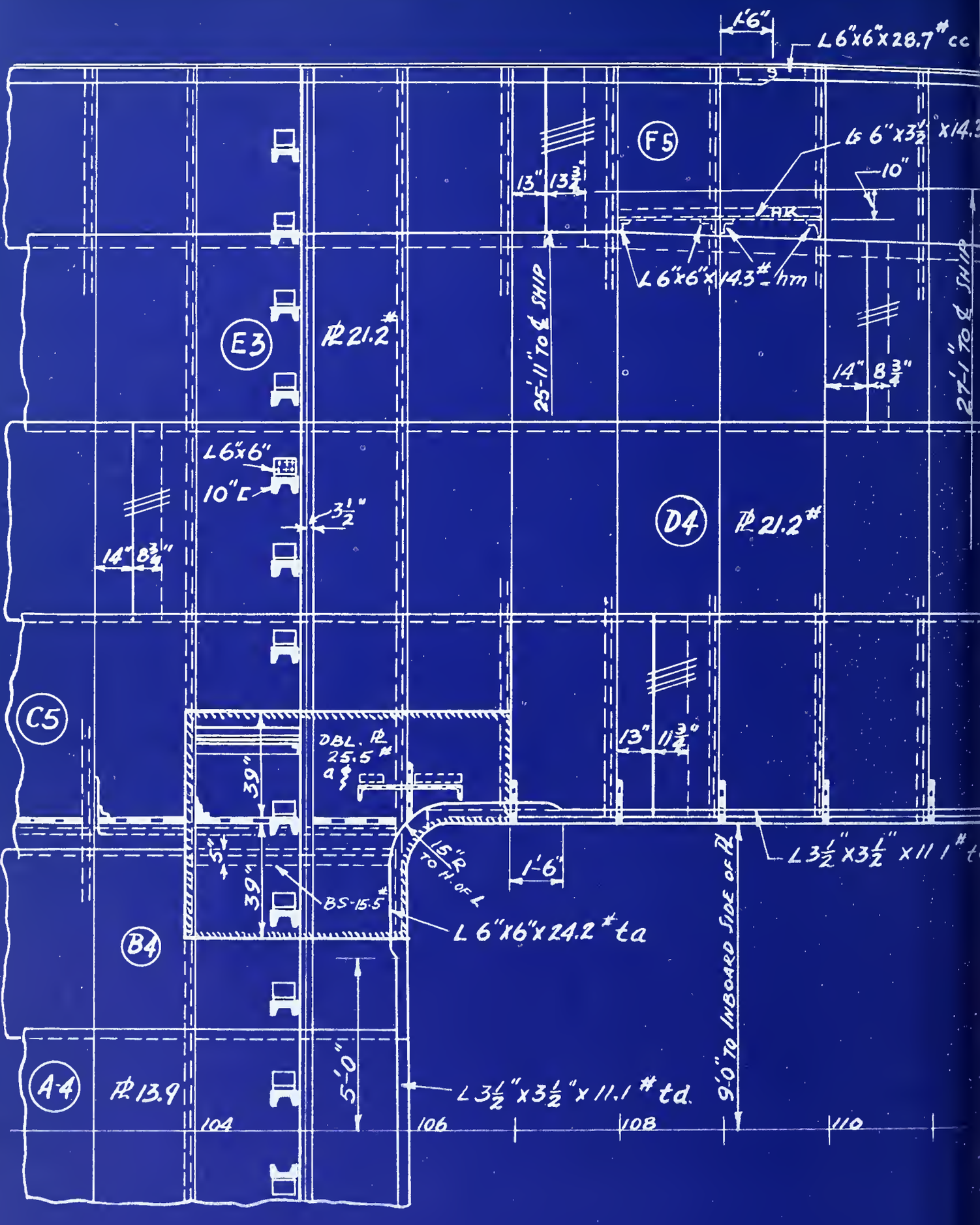
Cargo Vessel

Ship Hull Prints — Assignment Sheet

NAME — DATE — GRADE

Side Frame
Riveted Construction
Print No. 21

QUESTIONS	ANSWERS
1. What is the thickness of bracket at lower deck?	1.
2. How many rivets connect the bracket to lower deck beam?	2.
3. How wide is the stringer?	3.
4. How deep is the frame?	4.
5. Why is a liner fitted at lower deck bracket?	5.
6. What is the structural shape of the deck beam?	6.
7. What is the rivet spacing connecting frames?	7.
8. How deep is the stringer bracket?	8.
9. How thick is the stringer bracket?	9.
10. What is the length of the liner shown?	10.



UPPER DECK PLATING

Riveted Construction

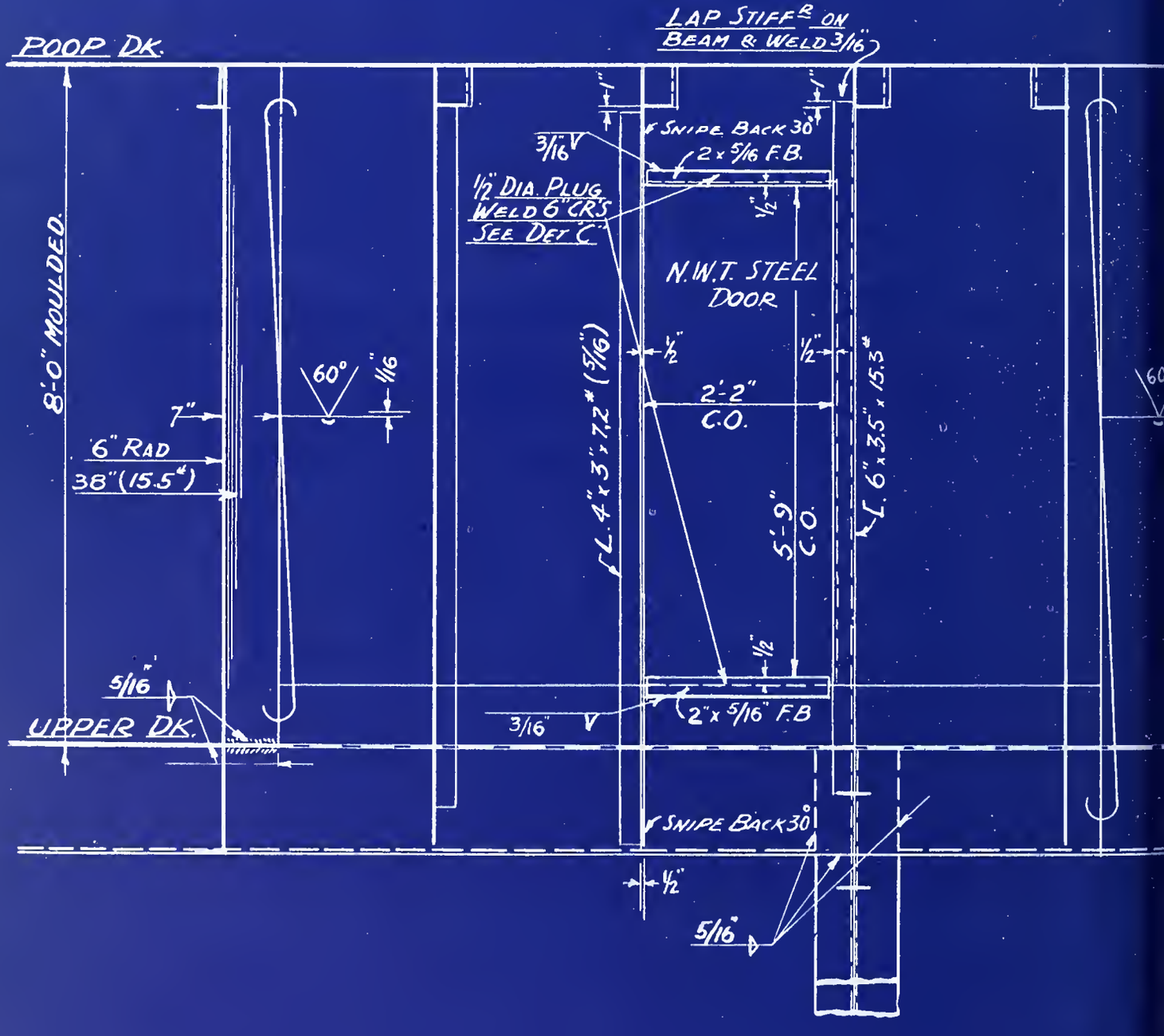
Cargo Vessel

Ship Hull Prints — Assignment Sheet

NAME — DATE — GRADE

Upper Deck Plating
Riveted Construction
Print No. 22

QUESTIONS	ANSWERS
1. Where is the doubler plate located?	1.
2. How many strakes of plating are on this deck?	2.
3. What are the weights of plates "A4", "D4", and doubler plate "ag"?	3.
4. Locate the butt on "C" strake; give the width of the butt and the number of rows of rivets used.	4.
5. What is the size of the hatch corner angle?	5.
6. What is the size of angle along the side and end of the hatch?	6.
7. What is the size of boundary angle at shell?	7.
8. What is the size of the bulkhead stiffeners' clips?	8.
9. Locate the butt of shell boundary angle.	9.
10. What is the width of the hatch?	10.



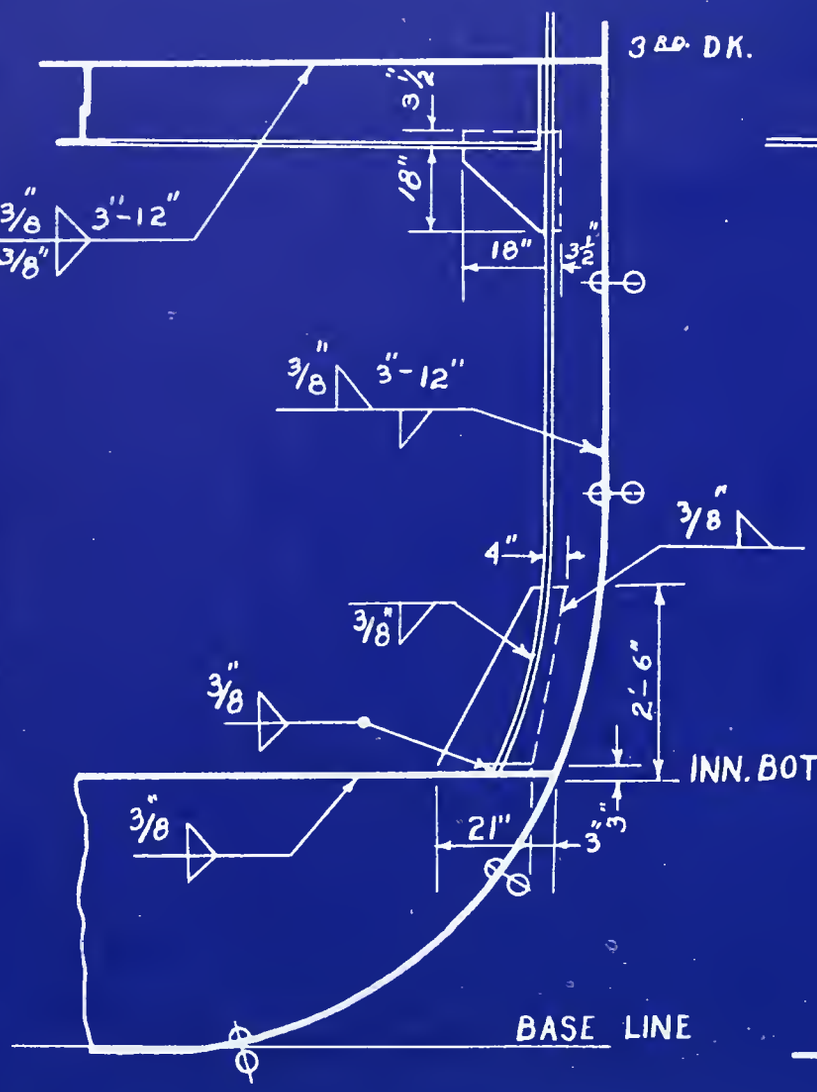
SECTION OF ENGINE CASING

Ship Hull Prints — Assignment Sheet

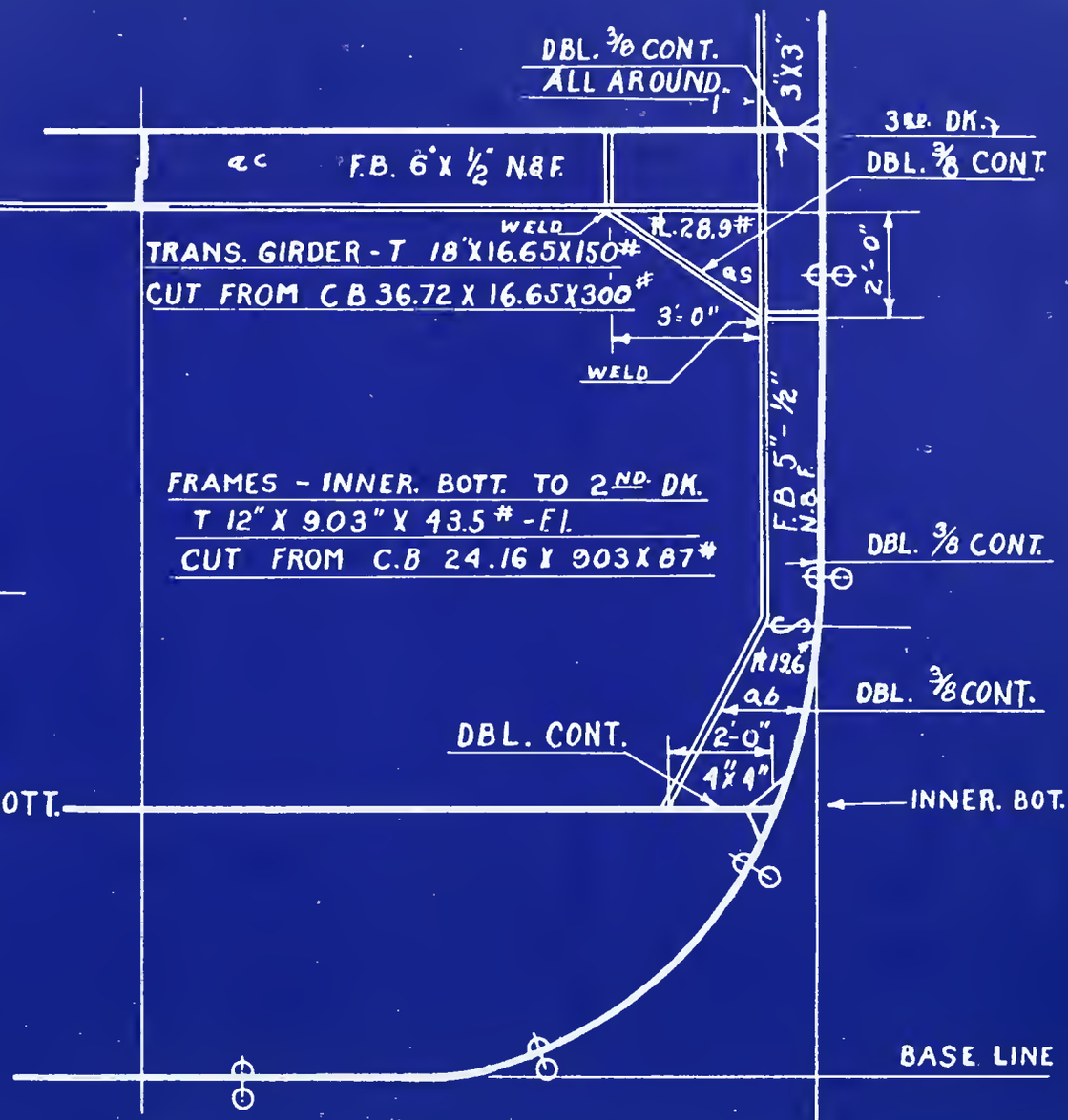
NAME — DATE — GRADE

Section of Engine Casing
Print No. 23

QUESTIONS	ANSWERS
1. What is the significance of the welding symbol 5/16" at the upper deck?	1.
2. What is meant by "snipe back 30°"?	2.
3. What is the size and type of weld used on the flat bars?	3.
4. What is meant by the welding symbol on the butt of the plates?	4.
5. Explain the meaning of 3/16" as used on the flat bars.	5.
6. Illustrate what symbol would be used to signify the weld, " ½" Dia. Plug Weld 6" CR's."	6.
7. What is the moulded height from the upper deck to the poop deck?	7.
8. What is meant by the welding symbol	8.



Section of Frame 106



Section of Transverse Frame 105

FRAMES

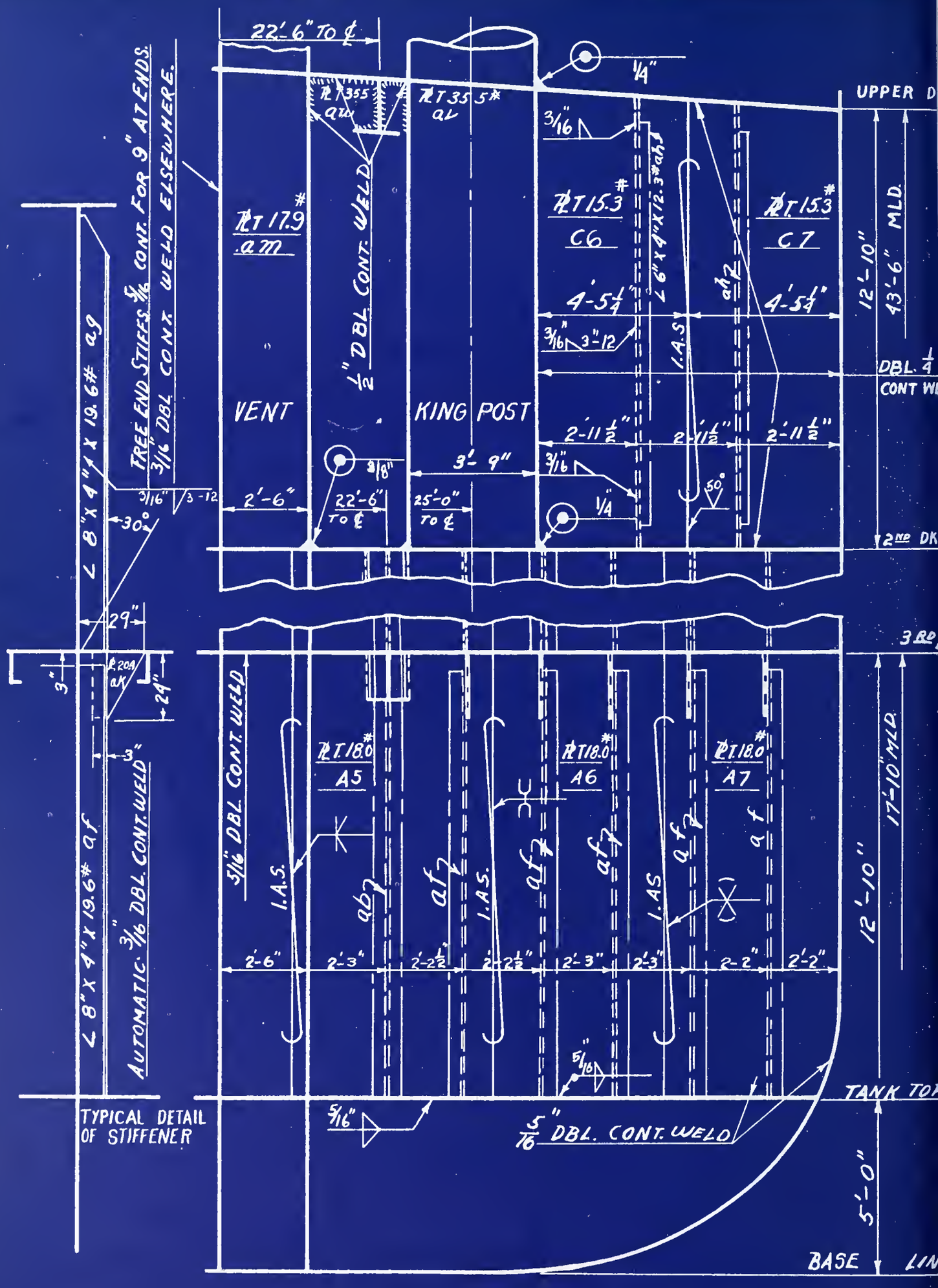
PRINT NO. 24

Ship Hull Prints — Assignment Sheet

NAME — DATE — GRADE

Frames
Print No. 24

QUESTIONS	ANSWERS
1. Explain the meaning of the welding symbol referring to the weld on the third deck frame 106.	1.
2. What is the size of the bracket connecting frame 106 to the inner bottom?	2.
3. Explain the meaning of the welding symbol referring to the weld at the side shell and frame 106?	3.
4. What is the difference between the welds at the side shell on frames 105 and 106?	4.
5. What is the thickness in inches of the plate "as", frame 105?	5.
6. Explain the meaning of the welding symbol referring to the weld where frame 106 attaches to the tank top.	6.
7. What is the size of the cut out where frame 105 joins the tank top?	7.
8. What is the size and structural shape of girder "ac", frame 105?	8.



TRANSVERSE BULKHEAD 114

Starboard Looking Forward Port Side Opposite

PRINT NO. 25

Ship Hull Prints — Assignment Sheet

NAME — DATE — GRADE

Transverse Bulkhead 114
Print No. 25

QUESTIONS	ANSWERS
1. Explain the meaning of the abbreviation and welding symbol in the butt of the plates "C6" and "C7".	1.
2. What type and size weld is used at the upper deck between the vent and king post?	2.
3. Explain the meaning of the welding symbol referring to the weld on the tank top.	3.
4. Explain the meaning of the welding symbol referring to the weld on the butt between plates "A6" and "A7".	4.
5. Explain the meaning of the welding symbol referring to the weld on the butt between plates "A5" and "A6".	5.
6. Explain the meaning of the welding symbol referring to the weld on the butt between plates "A4" and "A5".	6.
7. What type and size weld is used on the king post at the upper deck?	7.
8. What type and size weld is used on angle "ah"?	8.

APPENDIX I

SHIPBUILDING TERMS, DEFINITIONS AND ABBREVIATIONS

Appendix I

SHIPBUILDING TERMS, DEFINITIONS, AND ABBREVIATIONS

Terms and Definitions

A

ABAFT — Aft of; farther aft than.

ACCESS HOLES — Holes cut in ship's structure to permit entering or leaving various compartments.

ACCOMMODATION LADDER — A portable set of steps on a ship's side for the accommodation of people boarding from small boats or from a pier.

AFT — Toward, at, or near stern.

AFTER — Nearer stern.

AFTERMOST — Nearest the stern.

AFTER BODY — Hull form aft of the midship section.

AFTER PEAK — The compartment in the narrow part of the stern, aft of the last water - tight bulkhead.

AFTER PEAK BHD. — Watertight bulkhead farthest aft.

AFTER PERPENDICULAR — A vertical straight line at, or near, the after edge of rudder post.

AIR HAMMER — Hammer driven by compressed air for riveting, sometimes called an air gun or "gun".

AIR PORT — A circular opening or window through the ship's side, or deck house, for light or ventilation.

AMIDSHIPS — At or near the midship section of the ship.

ANCHOR — A heavy hook-shaped device for holding a ship at rest in water. The anchor grips the ocean bottom and is fastened to the ship by a chain.

ANGLE CLIP — A short piece of angle bar.

ANGLE COLLAR — A ring made of angle bar.

ANNEAL — To soften metal by heating and allowing it to cool slowly.

APERTURE — A recess in which the propeller is located.

APRON PLATE — Small plate on top of bulwark, at stem of vessel to stiffen bulwark.

ASSEMBLE — To fit together small parts, in making a large section, or part.

ATHWARTSHIP — Across the ship at right angles to the center-line.

AUXILIARIES — Machinery supplementary to main propulsive units.

AWNING DECK — Shade deck above another deck.

B

BALLAST — Any weight or weights (usually sea water) used to keep the ship from becoming "top heavy" or to change her trim.

BALLAST TANK — Watertight compartment to hold ballast.

BARNACLE — Small marine growth which attaches itself to a vessel's hull in large numbers, often greatly retarding her speed.

BATTENS — Long strips of wood used in the mold loft for fairing lines; also, wooden protective strips in cargo holds; see hatch battens.

BEAM — An athwartship member supporting a portion of a deck. Also, the width of the ship.

BEAM KNEE — (See Bracket).

BELOW — Below a deck or decks (corresponding to "down stairs").

BENDING ROLLS — Large machine used to give curvature to plates.

BENDING SLAB — Heavy cast iron perforated slabs arranged to form a large floor on which frames, etc., are bent.

BERTH — A place for a ship; a place to sleep; a bunk; also, a specified small section of the hull structure.

BETWEEN DECKS — The space between any two decks.

BEVEL — The angle between the flanges of a frame or other member. (When a greater than a right angle, open bevel; when less, closed). Also, to chamfer.

BILGE — Curved section between the botween the bottom and the side of a ship; the recess into which all water drains.

BILGE BLOCKS — Supporting blocks used under bilge for support during construction or dry-docking.

BILGE KEEL — A fore and aft member fitted to the outside of the shell plating along the bilge, to prevent excessive rolling of the ship.

BILGE PUMP — Pump for removing bilge water.

BILGE STRAKE — Course of plates at the bilge.

BILGE WATER — Water in ship due to leaks, sweat, etc.

BILGE WELL — A sump to which bilge water drains.

BINNACLE — A case, box, or stand containing a ship's compass, adjusting magnets, and a lamp for use at night.

BITT — A vertical post used in making fast lines; a bollard.

BITUMASTIC — An elastic cement used in place of paint to protect steel.

BOAT DECK — A deck on which life-boats are kept.

BODY PLAN — A drawing which shows frame lines in elevation.

BOILER — Container in which water is heated to form steam.

BOILER CHOCKS — Stay braces which prevent fore and aft movement of boilers.

BOILER FOUNDATION — A support for a boiler.

BOLLARD — A single tie post (see bitt).

BOOBY HATCH — A watertight covering over a deck opening, which is used for a stairway or ladder.

BOOM — A long, round, heavy spar, pivoted at one end, usually used for handling cargo, etc.

BOOM REST — A support for a boom when the boom is not in use.

BOOM STEP — A socket for end of boom.

BOSOM PIECE — A short piece of angle riveted over a butt joint of two angles, a butt strap for angle bars; a splice piece.

BOSS — The curved swelling portion of the ships hull around the propeller shaft.

BOSS FRAME — A hull frame which is bent for clearing propeller shaft tube.

BOSS PLATE — A shell plate covering the curved portion of hull where the propeller shaft passes outboard.

BOW — The forward end of a ship.

BRACKET — A triangular plate used to connect rigidly two or more parts, such as a deck beam to a frame, a frame to a margin plate, etc.

BRAZE — To heat and join by means of hard solder (spelter). This may be brass, bronze, or other alloys.

BREAKWATER — A braced guard plate which prevents solid water from sweeping the decks.

BREAST HOOK — A triangular-shaped plate extending horizontally across the bow behind the stem, stiffening the stringers and stem.

BRIDGE, NAVIGATING — A deck from which the ship is navigated.

BRIDGE DECK — A deck of the superstructure amidships.

BROW — A watershed over an airport; a small inclined runway to allow passage of trucks over hatch coaming, or through bulkhead door, etc.; sometimes portable.

BUILDING SLIP — A place where the ship is built; a shipway.

BULB ANGLE — An angle shape, which is reinforced at one toe.

BULB PLATE — A narrow plate reinforced on one edge.

BULB TEE — A Tee bar with toe of web reinforced.

BULKHEAD — A vertical partition corresponding to the wall of a room, extending either athwartships or fore and aft. A steel partition in a ship.

BULKHEAD SLUICE — A small opening in a watertight bulkhead which can be opened or closed from the deck above.

BULWARK — The ship's side above the weather deck.

BULL RIVETING — Driving rivets by squeezing them with a high powered air or hydraulic machine.

BUNKER — A compartment used for the stowage of coal or other fuel.

BUOYANCY — Ability to float; lifting power when immersed.

BUTT — The joint formed when two parts are placed edge to edge.

BUTTOCK — A distance from center line; an intersection of moulded surface with a vertical longitudinal plane.

BUTT STRAP — A small plate used to connect the two parts of a butt joint by overlapping each; a splice piece.

C

CAMBER — The athwartship rise or crown of a deck.

CANT FRAME — A frame which is not square to the keel line.

CAPSTAN — A revolving drum, with vertical axis, used for heaving in lines.

CARGO — The freight carried by a ship.

CARGO BATTENS — Strips of wood used to keep cargo away from the steel hull.

CARGO BOOM — A heavy boom used in handling cargo.

CARGO HATCH — A large opening in a deck which permits the loading of cargo into holds.

CARGO PORT — An opening in a ship's side used in loading and unloading cargo.

CASING — Bulkheads enclosing portion of vessel, as the boiler room casing. Also a covering for parts of machinery.

CAULK — To make a joint watertight.

CAULKER — One who caulks.

CEILING — Wood sheathing on the tank top, sides of ship, and bulkheads; used to protect cargo.

CENTER KEELSON — (See vertical keel).

CENTER LINE — The middle line of the ship, extending from stem to stern.

CHAFING PLATE — A bent plate used in minimizing chafing of ropes, as at hatches.

CHAIN LOCKER — A compartment in the forward portion of ship in which anchor chain is stowed.

CHAIN PIPE — A pipe for passage of anchor chain from deck to chain locker.

CHAIN RIVETING — Two or more rows of rivets spaces so that the rivets in one row are opposite those in an adjacent row.

CHAIN STOPPER — A device which prevents anchor chain from running out. It is moved into position after the anchor has been dropped.

CHAMFER — To cut off the sharp edge of a 90° corner. To trim to an acute angle.

CHART ROOM — A small room adjacent to the Pilot House in which charts and navigating instruments are located.

CHOCK — A heavy fitting through which ropes or hawsers may be led. A saddle or seat of wood or metal.

CHOCK - BOAT — A cradle or support for a lifeboat.

CHOCK - ROLLER — A chock with a sheave to prevent chafing of ropes.

CLEAT — A fitting having two arms or horns around which ropes may be made fast. A clip on the frames of a ship used to hold cargo battens in place.

CLINCHING PAN — A flat plate for clinching nails. (Used in the mold loft.)

COAMING — The vertical boundary of a hatch or skylight.

COFFERDAM — A narrow vacant space between two bulkheads. A double watertight bulkhead.

COLLAR — A flanged band or ring. A welded plate used to close a frame or beam penetration through plating.

COLLISION BULKHEAD — The watertight bulkhead nearest the bow of a ship; forepeak bulkhead.

COMPANIONWAY — A covered stairway leading downward from an open deck. A series of steps leading from the deck to a cabin or saloon below; also, the space occupied by these steps.

COMPARTMENT — A subdivision of space or room in a ship.

CORRUGATED — Having a series of wrinkles or grooves arranged so as to produce stiffness.

CORRUGATED BULKHEADS — Bulkheads with corrugated plating, eliminating the need for many welded stiffeners.

COUNTER — Overhang of the stern of a ship.

COUNTERSINK — To taper a hole for a flush rivet or bolt.

COWL — The hood-shaped top of a ventilator pipe.

CRADLE — A form on which bows, etc., are assembled. The support in which a ship rests during launching; a launching cradle.

D

DAVIT — A crane arm used in handling small boats, lifeboats, stores, gear, etc.

DEAD FLAT — A portion of a ship's side or bottom where the plating has no curvature; also, the midship portion of constant cross section. (The parallel middle body.)

DEAD RISE — The rise or upward slant of the bottom of a ship from the keel to the bilge.

DEADWEIGHT — The total weight of cargo, fuel, water, stores, passengers and crew, and their effects, which a ship can carry.

DECK — A part of a ship corresponding to the floor of a building.

DECK - HOUSE — A shelter built on deck.

DECLIVITY — Inclination of shipways to provide for launching.

DEEP TANK — A deep compartment usually extending from tank top to lower deck.

DERRICK — A device ior hoisting heavy weights, cargo, etc.

DIE — A tool for forming a rivet head (applied to rivet dies).

DISPLACEMENT — The total weight of the ship when afloat, including everything on board, (equals weight of water displaced.) Usually expressed in long tons.

DOG — A small bent metal fitting used in closing doors, hatch covers, manhole covers, etc.; a bent bar of round iron used in holding shapes on bending slab; any small flat lug temporarily welded to structure as backing for a wedge.

DOLLY BAR — A heavy bar to hold against a rivet, to give backing when riveting.

DOUBLE BOTTOM — Compartments at bottom of ship between inner and outer bottoms, used for ballast tanks, water, fuel oil, etc.

DOUBLING PLATE — A plate fitted outside or inside of another to give extra strength or stiffness.

DRAG — The amount the stern end of the keel is below the bow end when the ship is afloat, but not on an even keel.

DRAFT — The vertical distance of the lowest point of the ship below the surface of the water, when afloat.

DRIFT PIN — A small tapered tool used in aligning holes in adjacent members.

DROP STRAKE — A strake discontinued near the bow or stern.

E

ERECTING — The process of hoisting into place and bolting the various parts of a ship's hull.

EVEN KEEL — A ship is said to be on an even keel when the keel is level or parallell to the surface of the water.

EXPANSION TRUNK — Raised portion of tank used on some oil tankers to allow for the expansion of oil when temperature changes.

EYE BOLT — Bolt whose head is in the form of a ring or eye.

F

FABRICATE — To make raw material ready for assembling or erection.

FACE PLATE — A narrow stiffening plate welded along the edge of any web frame or stiffener.

FAIRING or FAIRING UP — Correcting or fairing up a ship's lines or structural members; assembling the parts of ship so that they will be fair, that is, without kinks, bumps or waves; bringing the rivet holes into alignment.

FAIRLEAD — A fitting through or over which a rope, line, etc., may be led so as to change its direction without excessive friction.

FAIRWATER — Plate or casting used to preserve streamline flow past hull structure or propeller hub.

FATHOM — Six feet.

FATHOMETER — A device to measure the depth of water, by timing the travel of a sound wave from the ship to the ocean bottom and return.

FAYING SURFACE — The contact surface between two adjoining parts.

FENDER — A portable device to protect a ship when bumping a pier; sometimes made of wood, rope, etc.; permanently installed extension which protects the hull of a ship in docking.

FIDLEY — Casing top over boiler room.

FIDLEY HATCH — A hatch over boiler room.

FLAGSTAFF — Flagpole at stern of ship; ensign staff.

FLANGE — A part of a plate or shape at, or nearly at, right angles to main part; to bend over to form an angle.

FLARE — The sudden widening of the shell at top near the bow.

FLAT — A small partial deck (built level) without curvature.

FLOOR — The lower portion of a transverse frame, usually a vertical plate, extending from center line to bilge, and from inner to outer bottom.

FORE AND AFT — In line with the length of the ship, longitudinally.

FORE AND AFT GANGWAY — A walkway between deckhouses at or near center line of ship.

FOREBODY — A hull form forward of the midship section.

FORECASTLE — The forward upper portion of the hull, sometimes used for the crew's quarters.

FOREFOOT — The part of the keel which curves and rises to meet the stem.

FOREPEAK — The large compartment or tank, at the bow in the lower part of the ship.

FOREPEAK BULKHEAD — Collision bulkhead; bulkhead nearest bow.

FORGING — Steel worked to special shape by hammering while red hot.

FORWARD — Near, at, or toward, the bow of the ship.

FORWARD PERPENDICULAR — A vertical line through the intersection of the stem with the load water line.

FOUNDATIONS — Supports for boilers, engines, and auxiliary machinery.

FOUNDATIONS, AUXILIARY — Supports for small machinery, such as winches, condensers, heaters, etc.

FRAMES — Ribs forming the skeleton of a ship.

FRAMES — CONTINUOUS — Frames combining side frames and floors.

FRAME, SIDE — Frame inside a ship, above and connecting to margin plate or floor plates.

FRAME SPACING — The fore and aft distance between adjacent frames.

FRAME, WEB — A heavy side or continuous frame, made with web plate for extra stiffness.

FREEBOARD — The vertical distance from the upper watertight deck to water line, when the ship is fully loaded.

FREEBOARD MARK — (See Plimsoll mark.)

FREEING PORT — Hole through bulwark which provides ready drainage of water from deck.

FUNNEL — A smokestack of a vessel.

FURNACE — A heater or large forge for heating plates or shapes for bending; to bend by heating in furnace.

G

GALLEY — A cook room or kitchen.

GALLEY DRESSER — A cook's work table.

GALVANIZING — Coating metal parts with zinc for protection from rust.

GANGWAY — A passageway, a ladder, or other means of boarding a ship.

GARBOARD STRAKE — The course of plates next to the keel of a ship.

GASKET — Packing of canvas composition, or other material, used in making a tight joint.

GIRDER — Fore and aft stiffening member for deck or bottom shell.

GIRTH — Any expanded length.

GRAB RODS — Bent rods welded to bulkheads or ship's side to form a ladder.

GRATING — Light platform or walkway built up of metal bars, used for access to machinery.

GROMMET — A soft ring used under a nut or bolthead to maintain water tightness.

GROSS TONNAGE — A figure obtained by dividing the total volume of the ship, in cubic feet, by 100.

GROUND WAYS — Timbers secured to the ground, under the hull on each side of the keel, on which a ship is launched.

GUDGEONS — Bosses on stern post drilled for pins (pintles) on which rudder swings.

GUNWALE — The junction of deck and shell at top of sheer strake.

GUNWALE BAR — Angle iron which connects stringer plate and shell plates. (Riveted work.)

GYRO - COMPASS — A mechanical compass operated by means of a gyroscope. This compass indicates true north rather than magnetic north.

GYRO - REPEATER — An apparatus to show the reading of the gyro compass at a distance from the main gyroscope equipment.

H

HATCH — An opening in a deck for passage of cargo, etc.

HATCH BATTENS — Flat bars which are wedged against hatch coamings to secure tarpaulins.

HATCH BEAM — A portable beam used to support wooden hatch covers.

HAWSE PIPE — Casting, or castings, through deck and side of ship at bow for passage of anchor chain.

HAWSER — A large rope used in towing or mooring.

HEELING — The inclination of a vessel to one side.

HOGGING — Straining of the ship which tends to make the bow and stern lower than the middle portion.

HOLD — The inside of a hull; cargo space.

HOLD BEAMS — Structural members placed in a hold, similar to deck beams, but having no plating or planking on them.

HOLDER - ON — One who "backs up" or "holds on" the head of a rivet while the point is being "driven", or upset.

HORN — To line or square up; also, part of a cleat.

HULL — The body of a ship, including shell plating, framing, decks, bulkheads.

I

I - BEAM — A structural shape with cross section resembling the letter I.

INBOARD — Inside of the ship; toward or nearer the center line.

INBOARD PROFILE — A drawing of the longitudinal section at center line of ship.

INNER BOTTOM — Plating forming the upper surface of the double bottom. Also called tank top.

INNER SHELL — A plated surface or "shell" inside the outer shell plating, used as additional protection in case of collision or other accidents. The space between the inner and outer shells is often used as a storage space for liquid ballast or cargo.

INSERTED PACKING — Red lead-soaked canvas strips placed between connections that cannot be caulked successfully; stop waters.

INTERCOSTAL — Made in separate parts; between frames, beams, etc.; the opposite of continuous. (Floors are continuous; longitudinal girders are intercostal in most cargo vessels.)

ISHERWOOD SYSTEM — A system of building ships in which the main framing is longitudinal or fore and aft, instead of transverse as in ordinary ships.

J

JACK STAFF — A flagstaff at the bow of a ship.

JOGGLE — An abrupt bend or offset in a plate, bar, or frame to eliminate the use of liners.

K

KEEL — The principal fore and aft member of a ship's frame. The keel runs along the bottom, connecting the stem and stern, and to it are attached the frames of the ship.

KEEL-BLOCKS — Heavy blocks which support the keel of the ship during construction.

KEEL, FLAT — The bottom shell strake on center line of ship.

KEELSON, SIDE — Fore and aft member placed on either side of, and similar to, the vertical keel.

KEEL, VERTICAL — Vertical plate used as reinforcement for keel, often called center-keelson.

KING POST — A stub mast, outward from center line, used to carry cargo booms; kingposts often serve as ventilators.

KNOT — A tie in a line. A nautical mile. (About one and one-seventh statute miles.)

KNUCKLE — A sharp bend in a plate or shape.

KNUCKLE PLATE — A plate bent to form a knuckle.

L

LADDER — Inclined steps, used aboard ship in place of "stairs".

LAP — A joint in which one part overlaps the other, thus avoiding the use of a butt strap; also, the amount of overlap.

LAUNCHING — The operation of placing a hull in the water by allowing it to slide down on greased skids, called launching ways.

LAYING OUT — Marking plates or shapes, for shearing, punching, etc.

LAZARETTE — Ship's storeroom between decks.

LENGTH BETWEEN PERPENDICULARS — The length of a ship measured from the forward perpendicular to the after perpendicular.

LENGTH OVER ALL — The length of a ship measured from the extreme forward end to the aftermost point of the stern.

LIFT — To make a template from measurements taken from the job.

LIGHTENING HOLE — A hole cut in any member to reduce its weight.

LIMBER HOLE — A small hole cut in a plate near the bottom to permit the passage of water.

LINER — A flat or tapered strip of steel placed under a plate or shape to bring the member in line with another which it overlaps. A filler.

LINES — The form of a ship as represented by its moulded surface.

LIST — To lean over to one side.

LOAD WATER LINE — Line of surface of water on a ship when loaded to designed draft.

LOFTSMAN — A workman in the mold loft, who lays down ship lines and makes templates.

LONGITUDINAL — A shell, deck, or bulkhead stiffener running fore and aft.

LUG PAD — A projection on deck with hole for fastening a block for a lead.

M

MAGNETIC COMPASS — A device which indicates the direction of magnetic north by means of a magnetized needle (or needles) which is attracted towards the Earth's magnetic pole. Magnetic north is not to be confused with true or geographical north.

MAIN DECK — Usually the deck immediately below the shelter or weather deck.

MANHOLE — A hole cut in a bulkhead, tank top, etc., to allow the passage of a man.

MARGIN PLATE — The outboard row of plates of the inner bottom, connecting to the shell plating at the bilge.

MARKER — A brass pipe dipped into paint which is used in marking rivet holes.

MARLINSPIKE — A pointed tapering tool which is used in separating strands of rope or cable in splicing.

MAST — A large long spar, placed nearly vertical on the center line of a ship.

MESS ROOM — A dining room for officers or crew.

MIDSHIP — At or near the middle point of a ship's length.

MIDSHIP SECTION — A cross section through the ship, midway between the forward and after perpendiculars.

MOLD LOFT — A shed or building with large, smooth floor on which the lines of a ship can be drawn to full scale.

MOORING — Securing a ship in position by several lines or cables, so that she cannot move or swing; anchoring.

MOORING PIPE — A casting which prevents chafing of mooring lines passing through bulwark plating.

MOULD or MOLD — A light pattern of a part of a ship; usually made of thin wood or paper. Also called a template.

N

NET TONNAGE — A figure obtained by making deduction from the gross tonnage for space not available for carrying cargo.

O

OAKUM — Untwisted fibres of old rope treated with a composition of resin and pitch, used to fill seams of wooden decks.

OFFSET — To move out of line or position.

OFFSETS — A table of moulded dimensions for water lines, decks, etc.

OIL TIGHT — Sealed by welding or caulking to prevent oil leakage. (Closer rivet spacing is required than for watertight work.)

OLD MAN — A rig for holding a drilling machine.

ON BOARD — On or in the ship.

ON DECK — On the upper deck; in the open air.

OUTBOARD — Away from the center line, towards the side of a ship.

OVERBOARD — Outside; over the side of a ship; into the water.

OVERHANG — That portion of the hull which is over and unsupported by the water.

OXTER PLATE — Bent shell plate which fits around upper part of stern post; also called tuck plate.

P

PACKING — Material which is placed between plates or shapes to make them watertight; wooden blocks and wedges which support a ship on sliding ways; spacers.

PAD EYE — An eye located on deck which is used for fastening cables; on the hull, an attachment for hanging a block and fall for lifting propeller or rudder.

PALM — Flattened top portion of rudder stock (for bolted connection). Also, a flat surface at the end of a strut or stanchion.

PANTING — An in-and-out movement of plating; to pulsate or throb. Panting may be caused by the lift and fall of a ship in a seaway, or by engine vibration.

PEAK — A narrow compartment at either end of a vessel.

PELORUS — An instrument used for taking directional bearings or sights, similar to a compass but without magnetic needles.

PILLAR — A vertical member or column which provides support to a deck girder. (Also termed a stanchion.)

PILOT HOUSE — An enclosed place in which the main steering wheel, controls, engine room telegraph, etc., are located. A wheel house.

PINTLE — A pin on which a rudder hinges.

PITCH — Spacing; as of rivets or gear teeth.

PLANKING — Wood covering for decks, etc.

PLATING — The plates of a hull, a deck, a bulkhead, etc.

PLIMSOLL MARK — A mark placed on the ship's side to indicate maximum allowable draft.

PONTOON HATCH COVER — A steel box-shaped member sometimes used in place of hatch beams to close in a cargo hatch.

POOP — The after, upper portion of the hull, often containing the steering gear.

POOP DECK — The first deck above the shelter deck at after end of a vessel.

PORT — A harbor; an opening in the side of a ship. The left hand side of a ship (looking toward the bow.)

PORTHOLE — A circular opening in the ship's side (see airport).

PROFILE — A side elevation of a ship's form.

PROPELLER — A rotating device which drives a ship through the water.

PROPELLER POST — The forward post of stern frame, which is bored for propeller shaft.

PROPELLER SHAFT — Rotating bar by means of which the engine turns the propeller.

Q

QUARTERS — Living or sleeping rooms.

R

RABBET — A depression or offset designed to take some other adjoining part; as for example, the rabbet in the stem to take the shell plating.

RAIL — The upper rounded edge of the bulwarks.

RAKE — Slope aft of a mast, kingpost or stack.

REAMING — Enlarging a rivet hole by means of a revolving, cylindrical, slightly tapered tool with cutting edges running along its sides.

REVERSE FRAME — An angle bar or other shape riveted to the inner edge of a transverse frame as reinforcement.

RIBBAND — A fore and aft wooden strip or heavy batten which is used to temporarily align the transverse frames after erection.

RIGGING — Ropes, wire ropes, lashings, masts, booms, etc.; also, the handling and placing on board the ship of heavy weights and machinery.

RIVET — A short round metal connection used to fasten two or more members together by clinching after being heated red hot.

ROLL — To impart curvature to a plate. Also, the motion of the ship from side to side, alternately raising and lowering each side of the deck.

ROLLER CHOCK — (See Chock Roller.)

ROSE BOX — A screen or strainer placed around the end of a bilge suction pipe.

RUDDER — A flat piece or structure of wood or metal attached upright to the sternpost (or in single screw-vessels, to the rudder post) of a vessel by hinges, or pintles and gudgeons, so that it can be turned, as by a tiller, causing the vessel's head to turn in the same direction, because of the resistance offered to the water by the rudder.

RUDDER POST — After post of stern frame to which the rudder is hung. (Also called stern post.)

RUDDER STOCK — The shank of a rudder which extends through shell upward to the steering engine.

RUDDER STOP — Lug to limit the swing of the rudder.

S

SAGGING — Straining of the ship which tends to make the middle portion lower than the bow and stern.

SAMSON POST — A heavy vertical post which supports cargo booms; kingpost.

SCANTLINGS — The dimensions of various shapes.

SCARF — To thin out or taper a corner or edge of a plate or shape to make a lap. A joint in a stem, bar keel or stern frame.

SCREEN BULKHEAD — A bulkhead, usually placed between the engine room and boiler room, which is fire proof, dust proof, and gas tight.

SCUPPER — A deck drain.

SCUPPER PIPE — A pipe which drains water from scuppers through the side of a ship.

SCUTTLE — A very small hatch; a manhole.

SCUTTLE BUTT — A container for drinking water.

SEA CHEST — A compartment through which sea water is admitted or discharged.

SEAM — A riveted or welded plate edge connection. A riveted seam overlaps; a welded seam may or may not overlap.

SET — Metal mold or template for use on bending slab.

SET IRON — A bar of soft iron used on bending slab to give shape of frames.

SHAFT ALLEY — A casing (large enough in which to walk), covering the propeller shaft and extending from engine room to after peak.

SHAFT TUNNEL — (See Shaft Alley.)

SHAPE — A bar of constant cross section, such as a channel, T-bar, angle bar, etc. Also, to impart curvature to a plate or other member.

SHEAR LINE — A line at which a shearing cut is to be made.

SHEARS — A large machine for cutting plates and shapes.

SHEER — Curvature of deck in a fore and aft direction as seen in profile. (See Part I — "Lines of a Ship".)

SHEER PLAN — A side elevation of ship's form; a profile.

SHEER STRAKE — The top full course of side shell plating.

SHELL EXPANSION — A plan showing details of all shell plating and shell longitudinals.

(Longitudinals would appear only on tankers.)

SHELL LANDINGS — Points on the frames where the edges of shell plates are to be located.

SHELL PLATING — The plates forming the outer skin of the hull.

SHELTER DECK — A continuous superstructure deck above the freeboard deck.

SHORE — A temporary brace or prop.

SIGHT EDGES — Visible edges of plating (outside shell and above decks).

SKYLIGHT — An opening in a deck to give air and light to the compartment below it.

SLIDING WAY — That part of launching way which moves with the ship.

SLOP CHUTE — Chute for dumping garbage overboard.

SOUNDING PIPE — Vertical pipe in oil or water tank used in measuring depth of liquid in tank.

SPAR — Long, round member such as mast or boom; part of rigging.

STABILITY — The tendency of a ship to remain upright.

STAGING — Planks or scaffolding on which to stand when working on sides or under decks.

STANCHION — A pillar or upright post.

STAPLING — Collars, forged from angle bars, which fit around continuous members passing through bulkheads or decks, to insure water tightness.

STARBOARD — The right hand side of a ship, looking forward.

STAY — A guy line.

STEALER — A plate extending into an adjoining strake as at the end of a drop strake.

STEERING GEAR — Apparatus for controlling the rudder.

STEM — Forging, casting, or plating forming extreme bow of ship and extending from keel to forecastle deck.

STEP — To set in place (as applied to a mast); also, a socket for the end of a mast; a support for the fixed or "hinged" end of a boom.

STERN — The after or back end of a vessel.

STERN FRAME — A large casting or forging attached to the after end of hull to form the ship's stern. It includes rudder post, propeller post, and aperture for the propeller.

STERN TUBE — A long bushing or bearing through the stern to support the end of a propeller shaft.

STIFFENER — An angle bar, T-bar, channel, etc., used to stiffen plating of a bulkhead or other member.

STOOL — A support for a propeller shaft bearing in the shaft alley. A foundation, etc.

STOP WATER — Canvas and red lead, or other material, fitted between two metal parts to make a watertight joint.

STOWAGE — A support or fastening for any gear, as, anchor or boat stowage.

STRAKE — A fore and aft course, or row, of shell or other plating.

STRINGER — A fore and aft member used to give longitudinal strength. Depending on location, these are called hold stringers, bilge stringers, side stringers, etc.

STRINGER, DECK — The strake of deck plating which contacts the shell.

STRINGER PLATE — A deck plate at the outboard edge of deck connected to the shell of a ship with an angle or a welded joint.

STRONG BACK — A supporting girder for a hatch cover; a rig used in straightening bent plates; a bar for locking cargo ports.

STRUT — A support for a propeller tail shaft (used on ships with more than one propeller).

SUPER - STRUCTURE — Deck houses, etc., which are located above shelter deck.

SWASH PLATE — A baffle plate in a tank which prevents excessive surging of a liquid.

T

TAIL SHAFT — A short section of a propeller shaft extending through the stern tube and carrying the propeller.

TANK TOP — The plating over the double bottom.

TARPAULIN — A waterproof canvas covering for a hatch or other purpose.

TEE - BAR — A structural shape with cross section resembling the letter T.

TELEGRAPH — A mechanically- or electrically-operated means of signalling from bridge to engine room, etc.

TEMPLATE — A mold or pattern.

THRUST BEARING — A bearing or block to resist end thrust. A bearing on propeller line shaft which relieves the engine from the driving force of the propeller.

THWART — A seat in a lifeboat.

TILLER — An arm, attached to rudder head, which operates the rudder.

TRANSOM — The main frame at the rudder stock (cant frames usually radiate from the transom frame).

TRANSVERSE — Athwartships; at right angles to the keel.

TRANSVERSE FRAMES — Athwartship members forming the ship's "ribs".

TRIM — To shift ballast; to cause a ship to change its position in the water; drag.

TRUNK — A small casing passing through a deck, such as is used for ladders or ventilation.

TUMBLE HOME — An inboard slant of a ship's side above the bilge.

U

UPTAKE — Connection between boilers and smokestack.

V

VERTICAL KEEL — A row of vertical plates extending along the center of the flat plate keel. It sometimes is called the center keelson.

VOICE TUBE — A large speaking tube.

W

WATER LINE — Any one of certain lines of a ship parallel with (and at various heights above) the base line. In half-breadth plans the water lines are smooth curves showing the shape of the ship; in profile plans they are projected as straight lines.

WATERTIGHT — So riveted, caulked, or welded as to prevent the passage of water.

WATERWAY — A narrow passage along the edge of a deck for drainage. A gutter.

WAYS — Timbers, etc., on which a ship is built or launched. (See Launching.)

WEATHER DECK — A deck exposed to the weather.

WEB — The vertical portion of a beam, the thwartship portion of a frame, etc.

WEB FRAME — A frame with a deep web.

WELDING — Fusing together two or more members with electric arc or by other means.

WELL — A cofferdam or a sump in the double bottom.

WHEEL — Nickname for propeller; steering gear control.

WINCH — A small hoisting engine; used in pulling lines, or in handling cargo.

WINDLASS — A machine used to hoist the anchors by winding in the anchor chain.

WIND SCOOP — A device used to divert air into a compartment of a ship.

Z

ZEE-BAR — A structural shape with a cross section resembling the letter Z.

ZIG-ZAG RIVETING — Two or more rows of rivets spaced so that the rivets of one row are offset.

Abbreviations Used by Shipfitters

AE — After end (rear or stern)
ALT — Alteration
AMM — Ammunition
A.P. — After peak
A.P. — After perpendicular
AUX — Auxiliary
B.A. — Bulb angle
BET — Between
BEV — Bevel
BHD — Bulkhead
BRKT — Bracket
B — Base line
B.M. — Bolted manhole cover plate
B/M — Bill of material
BOT — Bottom
BTK — Buttock
C — Channel or channels
CL or C — Center line
COFF — Cofferdam
CSK — Countersink holes
CSK-OS — Countersink other side
COMP'T — Compartment
COND — Condenser
CONN — Connection
C. to C. — Center to center
C. R. C. — Closed roller chock
C. T. C. — Closed towing chock
CTRS — Centers
C. V. K. — Center vertical keel
D or DIA — Diameter
DBLR — Doubler
DIM — Dimension
D(or DK — Deck
DN or DWN — Down
DR — Door
ELEV — Elevation
E. M. — Expanded metal
E. R. — Engine room
EXH — Exhaust
EXP — Expanded
f — Finish
F.B. — Flat bar
F.D. BLOWER — Forced draft blower
FDK — Forecastle deck
FE — Forward end (front or bow)
F.K. — Flat keel
FLG— Flange
F.O. — Fuel oil
FOCS'LE — Forecastle
FOR'D or FWD — Forward
FND — Foundation
F.P. — Forepeak or forward perpendicular
F.P. — Flanged plate
FR — Frame
F.W. — Fresh water
GALV — Galvanize
GEN — Generator
GIR —Girder
H — Hull or "H"-Beam
HLS — Holes
H.P. — High pressure or horse power
H.R. — Half round
I — "I"-beam
IB — Inboard
I.D. — Inside diameter
INV — Inverted
KP — Kingpost
L — Angle, locker, length, or longitudinal
L.B.P. — Length between perpendiculars
LBS or # — Pounds
L.O.A. — Length over all
L or LONG — Longitudinal
L.P. — Low pressure
LUB OIL — Lubricating oil
L.W.L. — Load waterline
MAX — Maximum
MIN — Minimum
M.L. — Moulded line
MLD — Moulded
M.P. — Mooring pipe
N — Near
NO-CSK — No countersink

NO or # — Number
N.W.T. — Non-water tight
OB — Outboard
O.C. — Open chock
O.D. — Outside diameter
OPP — Opposite side
O.S. — Other side
O.T.— Oil tight
O.T.H. — Oil tight hatch
P — Port
P.C. — Pitch circle
PDK — Poop deck
PLT or P — Plate
PLTG — Plating
PM — Pitch mark, check mark, or spot
R or RAD — Radius
R.C. — Roller chock
REQ — Required
RIV — Rivet
R.O.T.M.H. — Raised oil tight manhole
R.P.M. — Revolutions per minute
S or STBD — Starboard
SC.DR. — Screen door
SDK — Shelter deck
S — Shear or seam
S. N. W. T. — Steel non-watertight
S.P. — Shell plate
S.R. — State room
STIFF — Stiffener
STR — Stringer
S.W.T. — Steel watertight
T — "T"-bar
T.C. — Towing chock
TEMP — Template
THD — Thread
THK — Thick
TRANS — Transverse
T. S. — This side
T.S.U. — This side up
T.T. — Tank top
U — Up
UDK — Upper deck
V — Vent
V.K. — Vertical keel
V.L. — Vertical ladder
W — Weld
W.C. — Water closet
WL — Water line
W.R. — Wardrobe or washroom
W.T. — Watertight
W.T.M.H. — Water tight manhole
Z — "Z" bar

O — Midship section — universal as exchangeable material

WELDING ABBREVIATIONS

ABBREVIATIONS	EXPLANATIONS
I	Weld on the Inside of the ship's member
O	Weld on the Outside of the ship's member
A	Weld with an Automatic machine
M	Weld Manually
S	Welding to be done in the Shop
F	Welding to be done in the Field or on the ways
V	Weld Vertically
PA	Weld with a Portable Automatic machine

APPENDIX II

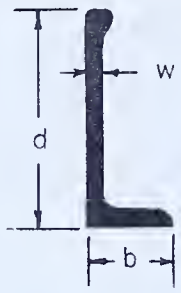
REFERENCE TABLES FOR SHIPFITTERS

Table of Thicknesses, Decimal Equivalents and Weights of Steel Plates

Thickness In Inches	Decimal Equivalents	Weight in Lbs. Per Square Ft.	Thickness In inches	Decimal Equivalents	Weight in Lb. Per Square F.
1/64	.0156	.638	33/64	.5156	21.05
1/32	.0313	1.28	17/32	.5313	21.7
3/64	.0469	1.91	35/64	.5469	22.3
1/16	.0625	2.55	9/16	.5625	22.95
5/64	.1781	3.19	37/64	.5781	23.6
3/32	.0938	3.83	19/32	.5938	24.25
7/64	.1094	4.46	39/64	.6094	24.87
1/8	.1250	5.10	5/8	.6250	25.5
9/64	.1406	5.74	41/64	.6406	26.18
5/32	.1563	6.38	21/32	.6563	26.8
11/64	.1719	7.02	43/64	.6719	27.4
3/16	.1875	7.65	11/16	.6875	28.05
13/64	.2031	8.30	45/64	.7031	28.7
7/32	.2188	8.93	23/32	.7188	29.35
15/64	.2344	9.58	47/64	.7344	30.0
1/4	.2500	10.20	3/4	.7500	30.6
17/64	.2656	10.85	49/64	.7656	31.26
9/32	.2813	11.50	25/32	.7813	31.9
19/64	.2969	12.12	51/64	.7969	32.5
5/16	.3125	12.75	13/16	.8125	33.2
21/64	.3281	13.40	53/64	.8281	33.8
11/32	.3438	14.03	27/32	.8438	34.4
23/64	.3594	14.68	55/64	.8594	35.1
3/8	.3750	15.30	7/8	.8750	35.7
25/64	.3906	15.95	57/64	.8906	36.4
13/32	.4063	16.60	29/32	.9063	37.0
27/64	.4219	17.22	59/64	.9219	37.6
7/16	.4375	17.85	15/16	.9375	38.25
29/64	.4531	18.5	61/64	.9531	38.9
15/32	.4688	19.14	31/32	.9688	39.6
31/64	.4844	19.79	63/64	.9844	40.2
1/2	.5000	20.4	1	1.0000	40.8

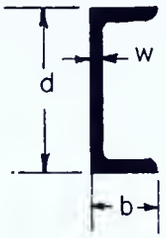
Sizes and Weights of Angles

Size	Thick-ness	Weight Per Ft.
8" x 8"	3/4	38.9
"	11/16	35.8
"	5/8	32.7
"	9/16	29.6
"	1/2	26.4
6" x 6"	7/8	33.1
"	13/16	31.0
"	3/4	28.7
"	11/16	26.5
"	5/8	24.2
"	9/16	21.9
"	1/2	19.6
"	7/16	17.2
"	3/8	14.9
5" x 5"	11/16	21.8
"	5/8	20.0
"	9/16	18.1
"	1/2	16.2
"	7/16	14.3
"	3/8	12.3
4" x 4"	11/16	17.1
"	5/8	15.7
"	9/16	14.3
"	1/2	12.8
"	7/16	11.3
"	3/8	9.8
"	5/16	8.2
3½" x 3½"	5/8	13.6
"	9/16	12.4
"	1/2	11.1
"	7/16	9.8
"	3/8	8.5
3" x 3"	1/2	9.4
"	7/16	8.3
"	3/8	7.2
"	5/16	6.1
"	1/4	4.9
2½" x 2½"	3/8	5.9
"	5/16	5.0
"	1/4	4.1
2" x 2"	3/8	4.7
"	5/16	3.92
"	1/4	3.19
8" x 6"	3/4	33.8
"	11/16	31.2
"	5/8	28.5
"	9/16	25.7
"	1/2	23.0
"	7/16	20.2
8" x 4"	3/4	28.7
"	11/16	26.5
"	5/8	24.2
"	9/16	21.9
"	1/2	19.6
"	7/16	17.2
7" x 4"	3/4	26.2
"	11/16	24.2
"	5/8	22.1
"	9/16	20.0
"	1/2	17.9
"	7/16	15.8
"	3/8	13.6
6" x 4"	3/4	23.6
"	11/16	21.8
"	5/8	20.0
"	9/16	18.1
"	1/2	16.2
"	7/16	14.3
"	3/8	12.3
6" x 3½"	11/16	20.6
"	5/8	18.9
"	9/16	17.1
"	1/2	15.3
"	7/16	13.5
"	3/8	11.7
5" x 4"	5/8	17.8
"	9/16	16.2
"	1/2	14.5
"	7/16	12.8
"	3/8	11.0
5" x 3½"	5/8	16.8
5" x 3½"	9/16	15.2
"	1/2	13.6
"	7/16	12.0
"	3/8	10.4
"	5/16	8.7
5" x 3"	9/16	14.3
"	1/2	12.8
"	7/16	11.3
"	3/8	9.8
"	5/16	8.2
4" x 3½"	5/8	14.7
"	9/16	13.3
"	1/2	11.9
"	7/16	10.6
"	3/8	9.1
"	5/16	7.7
4" x 3"	5/8	13.6
"	9/16	12.4
"	1/2	11.1
"	7/16	9.8
"	3/8	8.5
"	5/16	7.2
"	1/4	5.8
3½" x 3"	5/8	12.5
"	9/16	11.4
"	1/2	10.2
"	7/16	9.1
"	3/8	7.9
"	5/16	6.6
"	1/4	5.4
3½" x 2½"	3/8	7.2
"	5/16	6.1
"	1/4	4.9
3" x 2½"	3/8	6.6
"	5/16	5.6
"	1/4	4.5
3" x 2"	3/8	5.9
"	5/16	5.0
"	1/4	4.1
2½" x 2"	3/8	5.3
"	5/16	4.5
"	1/4	3.62



Weights and Thicknesses of Shipbuilding Bulb Angles

Depth of Channel d	Width of Flange b	Width of Flange b	Weight per Foot	Thick-ness Of Web W	Depth of Channel d	Width of Flange b	Width of Flange b	Weight per Foot	Thick-ness Of Web W
In.	In.	In.	Lb.	In.	In.	In.	In.	Lb.	In.
10	3.8	3-3/4	34.7	11/16	7	3.2	3-1/8	20.2	9/1
10	3.7	3-3/4	32.3	5/8	7	3.1	3-1/8	18.4	1/2
10	3.6	3-5/8	29.9	9/16	7	3.1	3	16.4	7/1
10	3.6	3-5/8	27.2	1/2	7	3.0	3	14.7	3/8
10	3.5	3-1/2	24.8	7/16	7	2.9	3	12.9	5/1
10	3.5	3-1/2	22.4	3/8					
9	3.8	3-3/4	30.8	11/16	6	3.7	3-3/4	17.4	1/2
9	3.7	3-3/4	28.6	5/8	6	3.6	3-5/8	15.9	7/1
9	3.6	3-5/8	26.4	9/16	6	3.6	3-5/8	13.9	3/8
9	3.6	3-5/8	23.8	1/2	6	3.5	3-1/2	12.3	5/1
9	3.5	3-1/2	21.6	7/16	6	3.5	3-1/2	10.7	1/4
9	3.5	3-1/2	19.4	3/8					
8	3.7	3-5/8	24.3	9/16	6	3.2	3-1/8	16.6	1/2
8	3.6	3-5/8	22.3	1/2	6	3.1	3-1/8	15.0	7/1
8	3.6	3-1/2	20.0	7/16	6	3.1	3	13.2	3/8
8	3.5	3-1/2	18.0	3/8	6	3.0	3	11.7	5/1
8	3.4	3-1/2	16.0	5/16	6	3.0	3	10.1	1/4
8	3.2	3-1/8	23.3	9/16	5½	3.2	3-1/8	14.9	1/2
8	3.1	3-1/8	21.4	1/2	5½	3.1	3-1/8	13.4	7/1
8	3.1	3	19.2	7/16	5½	3.1	3	11.7	3/8
8	3.0	3	17.3	3/8	5½	3.0	3	10.3	5/1
8	2.9	3	15.4	5/16	5½	3.0	3	8.9	1/4
7	3.7	3-5/8	21.1	9/16	5	2.7	2-5/8	12.6	1/2
7	3.6	3-5/8	19.3	1/2	5	2.6	2-5/8	11.3	7/1
7	3.6	3-1/2	17.1	7/16	5	2.6	2-1/2	9.8	3/8
7	3.5	3-1/2	15.3	3/8	5	2.5	2-1/2	8.5	5/1
7	3.4	3-1/2	13.6	5/16	5	2.4	2-1/2	7.3	1/4



Weights and Thicknesses of Ship Channels

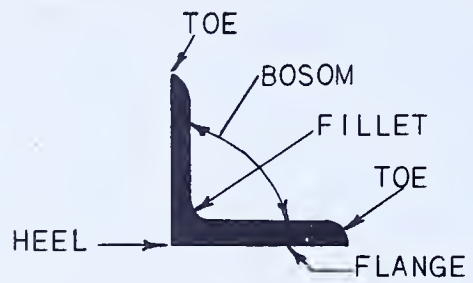
Depth of Channel d	Width of Flange b	Width of Flange b	Weight per Foot	Thickness of Web W
In.	In.	In.	Lb.	In.
13	4.4	4-3/8	50.0	13/16
13	4.3	4-1/4	45.0	11/16
13	4.2	4-1/8	40.0	9/16
13	4.1	4-1/8	37.0	1/2
13	4.1	4-1/8	35.0	7/16
13	4.0	4	31.8	3/8
12	4.1	4-1/8	50.0	7/8
12	4.1	4-1/8	48.6	13/16
12	4.1	4	46.6	3/4
12	4.0	4	44.5	11/16
12	3.9	3-7/8	40.0	5/8
12	3.8	3-3/4	35.0	1/2
12	3.7	3-3/4	41.1	11/16
12	3.6	3-5/8	37.0	5/8
12	3.5	3-1/2	32.9	1/2
12	3.5	3-1/2	30.9	7/16
10	4.2	4-1/4	37.0	11/16
10	4.1	4-1/8	33.6	9/16
10	4.0	4	30.2	1/2
10	4.0	4	28.5	7/16
10	3.7	3-3/4	35.1	11/16
10	3.6	3-5/8	31.7	9/16
10	3.5	3-1/2	28.3	1/2
10	3.5	3-1/2	26.6	7/16
10	3.4	3-3/8	24.9	3/8
10	3.6	3-1/2	25.3	7/16
10	3.5	3-1/2	23.6	3/8
10	3.5	3-1/2	21.9	5/16
9	3.7	3-3/4	31.6	11/16
9	3.6	3-5/8	28.5	9/16
9	3.5	3-1/2	25.4	7/16
9	3.5	3-1/2	23.9	7/16

Depth of Channel d	Width of Flange b	Width of Flange b	Weight per Foot	Thickness of Web W
In.	In.	In.	Lb.	In.
8	3.7	3-3/4	28.2	5/8
8	3.6	3-5/8	25.5	9/16
8	3.5	3-1/2	22.8	7/16
8	3.5	3-1/2	21.4	3/8
8	3.2	3-1/4	25.5	5/8
8	3.1	3-1/8	22.7	1/2
8	3.0	3	20.0	7/16
8	3.0	3	19.3	3/8
8	3.0	3	18.7	3/8
7	4.0	4	18.8	3/8
7	3.7	3-3/4	25.0	5/8
7	3.6	3-5/8	22.7	1/2
7	3.5	3-1/2	20.3	7/16
7	3.5	3-1/2	19.1	3/8
7	3.1	3-1/8	20.0	1/2
7	3.0	3	17.6	3/8
7	3.0	3	16.4	5/16
6	3.7	3-3/4	22.0	9/16
6	3.6	3-5/8	20.0	1/2
6	3.5	3-1/2	18.0	3/8
6	3.5	3-1/2	16.9	5/16
6	3.5	3-1/2	15.3	3/8
6	3.0	3	16.3	3/8
6	2.9	3	15.1	5/16
6	2.6	2-5/8	13.3	3/8
6	2.5	2-1/2	12.0	5/16
3	2.3	2-1/4	10.3	5/8
3	2.1	2-1/8	9.0	1/2
3	1.9	2	7.1	5/16
3	1.9	1-7/8	6.5	1/4
2-1/2	2.5	2-1/2	7.2	3/16
2-3/8	1.9	1-1/4	3.87	1/4

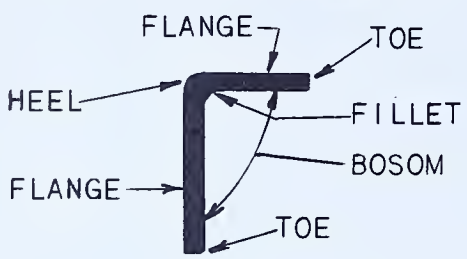
APPENDIX III

STRUCTURAL SHAPES

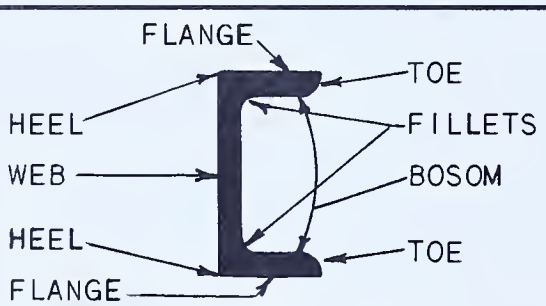
Structural Shapes



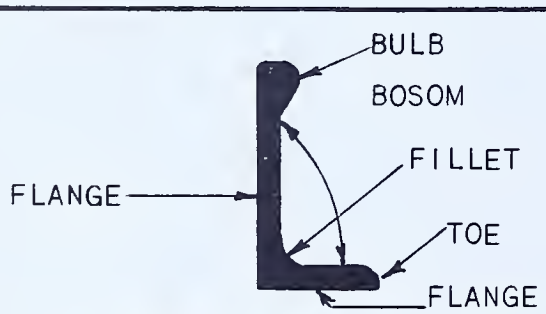
ANGLE OF EQUAL LEGS – NOTED ON DRAWING AS 3½"x3½"x11.1# ANGLE OR IF DOUBLE 3½"x3½"x11.9# DOUBLE ANGLES



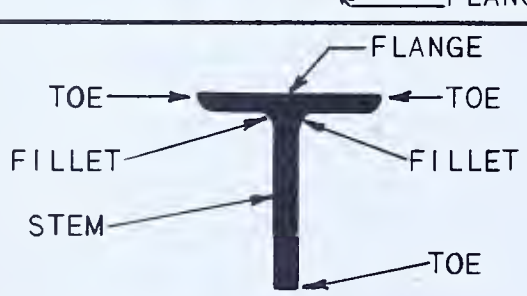
FLANGED PLATE – NOTED ON ON DRAWING AS 6"x12"x35'–0"x20.4#



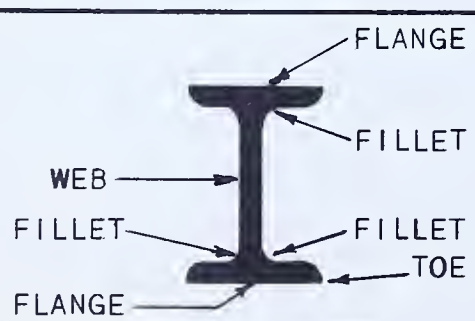
SHIPBUILDING CHANNEL – NOTED 10"x3½"x23.6# OR CHANNELS



BULB ANGLE – NOTED 10"x3½"x18.0# BULB ANGLE

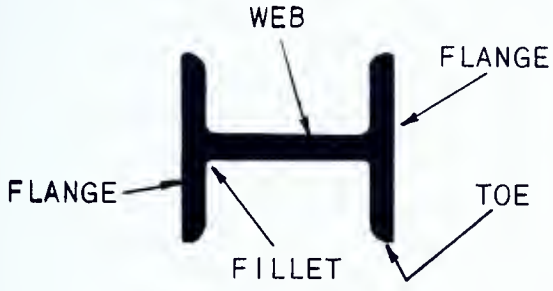


TEE-BAR – NOTED 6½"x6½"x19.8# T

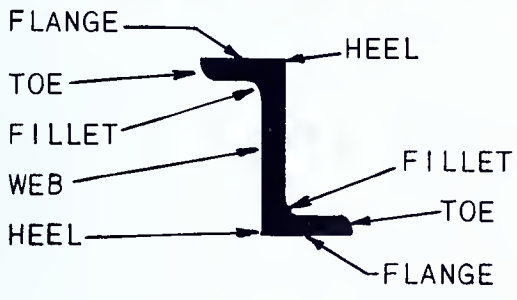


I–BEAM DEPTH ALWAYS GREATER THAN FLANGES NOTED 12"x6½"x32.0# I – USED MAINLY IN HORIZONTAL POSITION AS BEAMS

Structural Shapes



H-BEAM DEPTH AND FLANGE WIDTH NEARLY SAME WIDTH NOTED – 10"x10"x77# H



Z-BAR – NOTED 6"x3½"x15.7# Z

HATCH SECTION – NOTED ON DRAWINGS AS TYZACK SECTION OR BUILT UP HATCH SECTION

SOLID HALF ROUND – NOTED ON DRAWINGS AS 3"x1½" H.R.–ETC.

HALF OVAL – NOTED ON DRAWINGS AS 6"x¾" HALF OVAL–ETC.

HOLLOW HALF ROUND – NOTED ON DRAWINGS AS 3"x½" HOLLOW H.R.–ETC.